JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXXVII NO. 26 | SAN FRANCISCO, DECEMBER 23, 1916 | PER COPY, 25 CENTS

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BY WALTER HAYNES.

ELECTRICITY AT THE BUNKER HILL & SULLIVAN MINE.
BY WALTER C. CLARK.

PREPARATION OF FOOD FOR ELECTRIC RANGE COOKING.
BY E. A. WILCOX.

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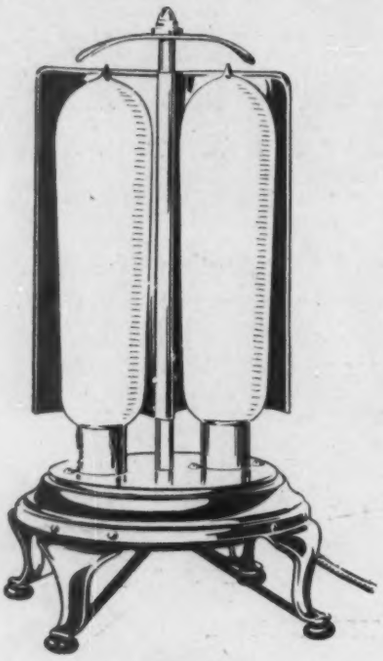
Alphabetical Index to Advertisers, Page 8 Where to Buy It in the West, Page 9



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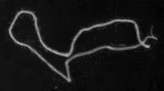

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JOURNAL OF ELECTRICITY
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VOLUME XXXVII SAN FRANCISCO, DECEMBER 23, 1916 NUMBER 26

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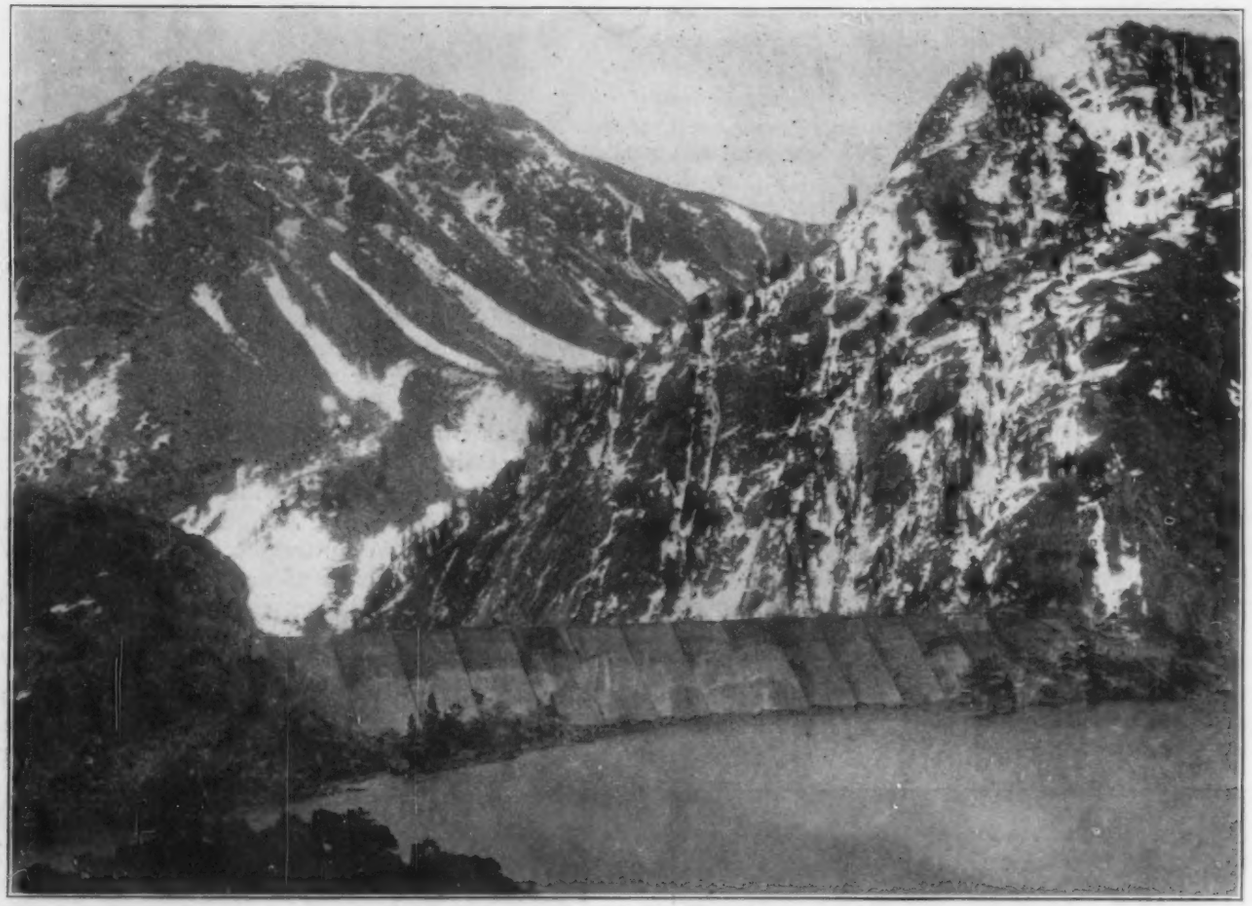
MULTIPLE ARCH DAMS ON RUSH CREEK

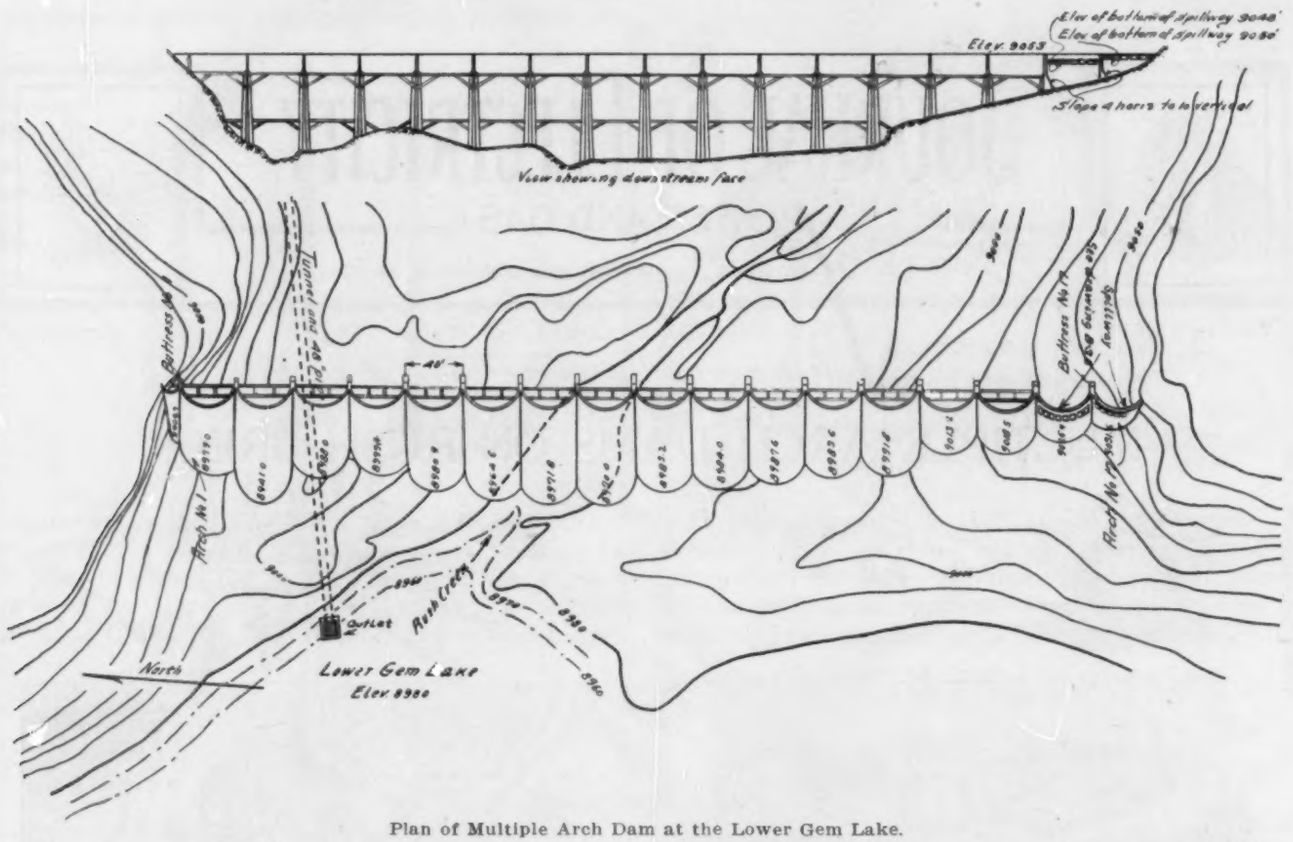
In order to more fully develop and utilize the Rush Creek water resources for power and irrigation purposes, it became necessary to construct two storage reservoirs on the upper drainage area. Two natural lakes, Gem and Agnew, already existed, and the owners of the water rights, the Pacific Power Corporation, of Bodie, California, decided to develop these two lakes by building dams across their outlets, and to utilize the water in a power house located at Silver Lake, some 1800 ft. (in elevation) below Gem Lake.



The Gem Lake Dam of the Rush Creek Development.

To fully equate the stream in an ordinary year, it was found that an artificial storage of 17,000 acre feet would be necessary at Gem Lake. This necessitated a dam 84 ft. high, and 700 ft. long at the original lake outlet. The available drainage area is 22½ square miles, and it is estimated that this area will yield an average of 2 second feet per square mile. It is all located between elevations 9,000 and 12,000 ft. above sea level on the eastern slope of the Sierra Nevada Mountains.

This drainage area is covered with a fair growth of pine trees up to elevation 11,000. From these trees the form lumber used in the construction of the two dams was cut to the amount of about one million board feet. The quality of the timber was not the best, but answered the purpose.



Plan of Multiple Arch Dam at the Lower Gem Lake.

For the dams it was decided to use the multiple arch type, or Jorgensen design, and have the two dams nearly alike, except as to size.

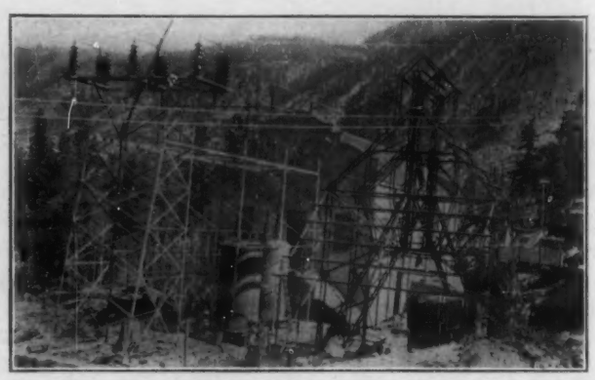
The largest of the two dams is the one at Gem Lake, and consists of sixteen full arches and two fractions at the ends. Each arch has a span of 40 ft., making the total distance across the crest approximately 700 ft. The height of this dam is 84 ft. to a point where arch action ceases, but the foundation extends down 112 ft. below the crest elevation (9053) on two arches, across what was apparently an old creek bed. The accompanying plans show the details of the structure. The upstream face of the dam slopes 50 deg. with the horizontal plane, and has the shape of a true cylinder from the bottom up to within 15 ft. from the crest. From elevation 15 to the crest, the shape gradually changes to a typical ellipse, in order that the center line (axis) of the arch may coincide with the center line of pressure, or at least the two be brought very close together.

On account of the slope given to the arch for purposes of stability, the load is not uniformly distributed on the arch from the springing line towards the crown, but is greatest at the spring line, due to the fact that any point here is submerged 7 ft. deeper than any corresponding point at the crown. This has a large effect on the stability of the arch towards the crest and necessitates the changing of the shape of the arch from circular to elliptical above elevation 15, or necessitates the making of this portion vertical.

The downstream face of the buttresses is shaped such that the center line of pressure coincides with the center line of the buttresses, at least in the lower portion. In the upper portion the center line of pressure lies upstream relative to the middle line of the buttress to avoid having the buttress appear too slender.

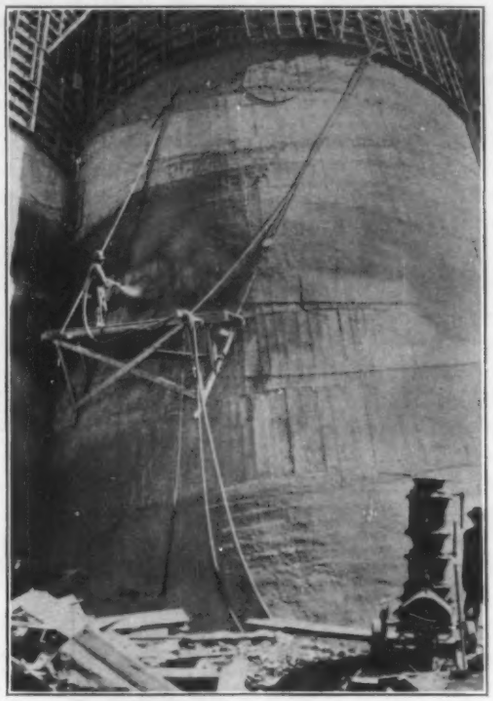
The buttresses are tied together by means of struts as shown on the plans, and are reinforced, although not to any great extent. The arches are more heavily re-

Multiple Arches for the Agnew Dam.



Power Station and Transformer House Under Construction.

inforced, the steel being placed in such a way as to prevent cracks in the concrete when the reservoir is empty in cold weather. For the purpose of watertightness the upstream face was plastered by means of a cement gun. This plaster as put on is ¾ in. thick at the bottom, and ¼ in. thick at the top. This work,



Cement Gun in Operation on the Arches of the Gem Lake Dam.

however, is not quite completed, as the temperature dropped too low to continue operations until completion this year.

The outlet from the lake is 48 in. diameter pipe laid through a short tunnel underneath the dam. The floor of the tunnel is 20 ft. below the original natural lake level.

The Gem Lake dam contains 8537 cubic yards of concrete. For the buttresses 1¼ barrels of cement per yard was used, and for the arches 1½ barrels of ce- yard was used, and for the arches 7½ barrels per yard. Good sand, with about 3½ per cent of clay mixed in it, was found at the lake shore near the mixing plant. Rock was taken from a slide about ½ mile away and hauled on a tramway to the works. This rock was crushed to about 2 in. maximum size, and screened into two sizes in addition to the sand that was formed. These three piles were again mixed with additional lake sand.

A mushy mix, using about 10 per cent of water, was put into the arches where the concrete would have to flow around the reinforcement. For the buttresses concrete of a somewhat dryer consistency was found permissible, and about 9 per cent of water to total weight of aggregate was used for this mix.

The concrete was tested at intervals, and the crushing strength of 8 in. diameter cylinders averaged about 900 pounds per square inch when 14 days old. The tensile strength of mortar briquettes 1:2½ averaged a little less than 200 pounds per square inch when 24 hours old, and 575 pounds per square inch when six months old. In this connection it should be mentioned that the maximum stress in the structure is about 275 pounds per square inch compression with reservoir full to the crest at elevation 9053.

The small dam at Agnew Lake is of similar design, and consists of 7 arches. It has a maximum height of 30 ft. The outlet is a 30 in. pipe through one of the deepest arches, with a slanting grizzly in front. This reservoir is considered as a forebay for taking care of peak loads. It is situated about 550 ft. lower in elevation than Gem Lake, and has a drainage area of 1⅝ square miles of its own.

The design of the two dams was made by L. Jorgensen of San Francisco, who also acted as construction engineer. C. O. Poole was chief engineer for the whole development. E. J. Waugh was resident engineer, L. B. Curtis, field engineer, and F. O. Wolson, superintendent of construction. Duncanson Harrelson Co of San Francisco were the contractors on the dams.

CALIFORNIA INDUSTRIAL ACCIDENT COMMISSION'S REPORT.

The report of the Industrial Accident Commission of the State of California for the fiscal year ending June 30, 1916, has been published. Accompanying the report is statistical information concerning industrial injuries during 1915, which are divided into three main groups: Deaths, 533; permanent injuries, 1264; temporary injuries, 65,741; total, 67,538.

The commission refers with pardonable pride to the reduction of 158 deaths in the comparison between the figures of 1914 and 1915. In the year first mentioned there were 691 deaths among California's workers, as against 533 last year. A similar comparison shows 28 fewer permanent injuries last year than during 1914. There were exactly 5500 more temporary injuries reported last year than during 1914. This is accounted for by the growth of business as the population increases and also by the closer observance of the law requiring the reporting of industrial injuries. The reports cover the three main departments of compensation, insurance and safety.

More and more as time goes on it has been found advantageous to rate permanent injuries on the loss of earning power, based on the nature of injury or disfigurement, the occupation and the age. It was found necessary to make provision for additional injuries and to make the schedule more elastic. There were 549 permanent injuries rated during the first six months of 1916 and in 1915 there were 867 permanent injuries rated.

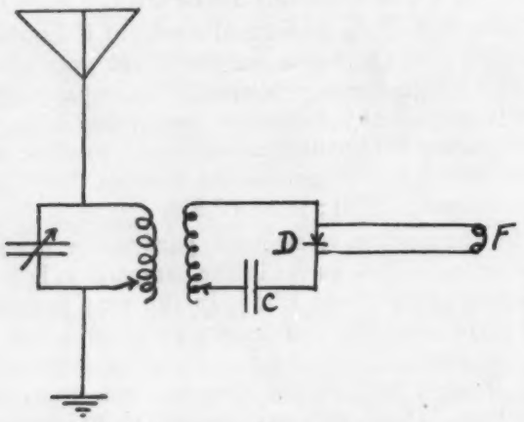
The income of the State Compensation Insurance Fund to June 30, 1916, had reached $1,837,760.70. The expenditures and reserves amounted to $1,461,315.35. Refunds to policyholders have been paid to the extent of $134,381.98, leaving a net surplus of admitted assets over liabilities of $242,063.37. The dividends declared have amounted to 15 per cent of the premiums earned during the years 1914 and 1915. The total will probably exceed $170,000 when pay rolls of all insured employers have been ascertained.

WIRELESS TELEPHONY.

BY WALTER HAYNES

Just as radio telegraphy is a specialized branch of electrical engineering, so is radio telephony a subbranch of radio telegraphy, and as such presents few new problems. Indeed the similarity between the two is almost exactly analogous to ordinary wire telegraphy and telephony. In telegraphy intelligence is transmitted by means of the intermittent passage of a current through the circuit, the periods of current flow and cessation being interpretable into a code having a previously assigned meaning and in telephony intelligence is transmitted by so operating on the electric current that it will in turn cause the air in the vicinity of the receiver to be disturbed approximately proportional to the sound waves used to excite the transmitter.

The nature of sound waves (including voice) is well understood. The frequencies of voice waves vary from about 75 to 2300 complete waves per second, while the upper limit of audible frequency is around 45,000 for the normal human ear.



Connections for Wireless Telephony

We may now enunciate on a priori principle. If, as we have already seen, a current of an inaudibly high frequency can be generated and a transmitter can be found for varying the amplitude of this current, it will be at once possible to pass the modified current into an antenna and thereby radiate a train of ether waves having all the peculirities imposed upon the original current by the transmitter. (The problem of reconverting the energy of these trains of ether waves to sound waves will be taken up presently).

Two general methods are used in radio telephony for varying the amplitude of the radiated ether waves, namely: Varying the magnitude of the antenna current by means of passing it through a transmitter whose resistance varies with the character of sound waves to be transmitted, or:

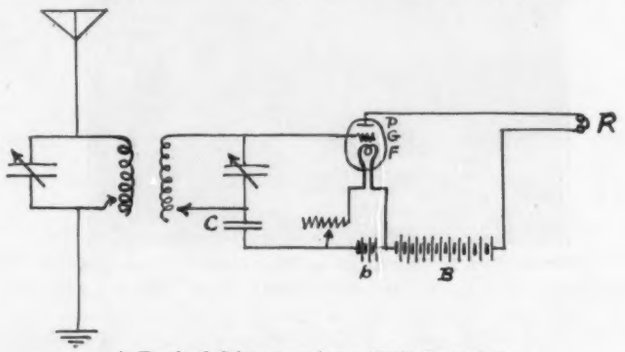
Using the modified current from the transmitter in an auxiliary circuit for triggering off or relaying larger quantities of electrical energy to the antenna.

Almost numberless variations of both these methods, and some entirely unique but commercially worthless schemes besides have been proposed, but a one evening lecture prevents more than passing mention.

The first of the above methods has been used considerably for small powers covering distance up to at least 600 miles. Any high frequency alternating current source may be used to supply the primary energy. The oscillating arc is perhaps most commonly used.

The second method now almost universally uses some sort of vacuum bulb having at least three and usually four electrodes. Oscillating circuits are established between certain of the electrodes and link the antenna and generator together through a section of the bulb that lies between another pair of electrodes. A triggering e.m.f. is set up between these latter electrodes, which, through the agency of its electro-static field partially or wholly diverts the cathode stream from the main circuit anode, thus varying the antenna current and, through it the radiated energy. Excellent results have been gotten with this type of transmitter.

One thing is common to all forms of long wave ether radiation, that is their detection. The earliest practical detector discovered by Branley, consisted of a small quantity of conducting filings so placed as to



A Typical Diagram for a Bull Detector.

bridge a small gap between the antenna and ground. This gap served as a key for operating a local bell or sounder. It had the property of reducing its resistance many hundreds of per cent when acted upon by ether waves, but when once its resistance was reduced, it remained so and the bell rang until it was "decohered" by a jar. Locating the bell clapper where it jarred the coherer while ringing solved the decohering problem, but the coherer was soon discarded because of its lack of sensitiveness.

Magnetic detectors were the first really commercial detector to be developed and used. The principle underlying the working of this detector is that an oscillating current tends to reduce the effectual residual flux in any magnetic circuit around which it is passed. Therefore, any auxiliary coil about the aforesaid flux path will have induced in it an e.m.f. which would produce a click in a telephone receiver connected thereto. The more nearly saturated the steel, the greater would be the variation (or reduction) of flux for a given oscillating current. In order to have a fresh, strong field, Marconi passes an endless steel or iron band past the poles of a magnet just as it enters the coil which carries the antenna current. The magnetic detector, however, lacks sensitiveness, for which reason it has been superseded in late years by various other types.

Several of the most reliable types of detectors, for all around use, depend upon the establishment of thermal e.m.f's. between their terminals when currents are passed through them. The usual form employs a mineral crystal rather firmly held in a "crystal cup" of any metal for one terminal while a small wire "cat-whisker, or pointed piece of some other crystal resting lightly thereupon, constitutes the other detector terminal. The simplest detector circuit is shown in Fig 6, where D, C and F denote a detector, a stopping condenser, and a pair of telephone receivers, respectively.

It will be observed that the passage of a train of current waves through D will create a pulse of direct current through the telephones since C opens the path through the inductance. Certain of these mineral crystal detectors are found to be more sensitive if a slight external e.m.f. be applied to them by means of a potentiometer and battery. It seems proper, in passing, to call attention to the electrolytic detector. This detector consists of a platinum wire about 0.003 millimeter in diameter—dipping into a twenty per cent solution of nitric acid in water. In operating, a slight e.m.f. is applied to its terminals. The corrosiveness of the acid and the ease with which a heavy antenna current melts off the platinum wire, have forced this detector into disfavor with operators, but in the laboratory it corresponds to the standard cell, the sensitiveness of all other detectors are rated in terms of the electrolytic.

Several makes of detectors have come into prominent use in late years which embody the rectifying power of an electronic discharge of a hot metal in a high vacuum.

A typical wiring diagram for an ordinary bulb detector is shown in the illustration where R and C are the telephone receivers and stopping condenser respectively, and F, G and P are the hot filament, grid and plate respectively, of the "bulb." A section of the battery, b, is used for heating the filament. Another section B, is so adjusted that the potential between F and P is just insufficient to maintain a constant stream of electrons, or, in other words, an electric current from F to P and through the telephones, F. But the oscillating potential to which b is subjected (when the antenna is excited), is alternately of such sign as to increase the potential of B, and, therefore, cause pulses of current through the receivers. The potential of G between these pulses is of opposite sign (—) which suppresses the electronic migration from F to P, and thus also, the current through F.

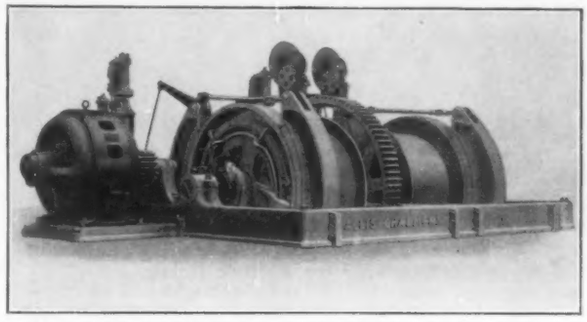
This type of detector is very satisfactory in that it does not "jar out" and hence is unaffected by the rolling of a ship, and withal, it is a very sensitive wave indicator. The most serious drawbacks are its cost, liability to burn out, and the necessity of having to provide so much battery.

Almost numberless types of wave indicators working upon unique and ingenious principles have been invented and all but forgotten in the light of later discoveries. Since no attempt is made here at completeness, only the epoch-making strides have been mentioned.

ELECTRICITY AT THE BUNKER HILL & SULLIVAN.

BY WALTER C. CLARK.

Electricity was first applied to the operations of the Bunker Hill Mine at Kellogg, Idaho, in 1893 when there was installed on No. 3 level an electric hoist operated by a 500 volt d.c. Edison Bi-polar motor supplied with power from a generator of the same type driven by a Pelton water wheel controlled by Woodward governor and butterfly valve. Water for this installation was taken from Milo Creek. This equipment constituted practically all the electrical machinery used in the mining operations until 1897 when the big Kellogg tunnel was started and equipped with a 4½ ton General Electric 500 volt trolley locomotive which is still in operation and giving good service. Direct current for this trolley locomotive was supplied from a General Electric multipolar 500 volt generator driven by a turbine water wheel supplied with water from the South Fork of the Coeur d'Alene River.



The Electric Hoist at the Bunker Hill & Sullivan Mine.

In 1901 the Washington Water Power Company canvassed the district and secured sufficient support to justify building high tension lines into the district to supply electrical energy for mining and milling purposes. In August, 1903, their transmission line from Spokane was put into operation. The first Bunker Hill substation was equipped with one 275 k.v.a transformer.

The present substation is equipped with seven 650 k.v.a. transformers, stepping down from 60,000 volts to 2300 volts for delivery to the Bunker Hill lines.

With the advent of the Washington Water Power Company into this district the extreme flexibility and adaptability of electrical energy became more and more evident. Its popularity is shown by the following table which gives the yearly increase to the Washington Water Power substation at this property:

	Capacities Substation in k.v.a.	Kw.-hr. Used for Year.	Tons Ore Mined for Year.
1903.....	275	288,000	260,900
1904.....	500	915,100	288,332
1905.....	550	1,050,800	304,380
1906.....	600	1,456,000	347,300
1907.....	650	2,470,600	336,330
1908.....	950	2,885,650	335,070
1909.....	1260	4,866,550	345,270
1910.....	1900	6,973,180	377,530
1911.....	1900	7,892,000	432,290
1912.....	1900	7,292,000	434,800
1913.....	3250	8,629,500	435,000
1914.....	3700	9,244,300	440,000
1915.....	4250	10,979,000	455,000

All of the present transformer equipment in this substation is not used by the Bunker Hill Company

as lines have been run to the Stewart mine, to the Pine Creek district, to the Hypotheek, Roanoke and Polaris properties. The application of electricity to the Bunker Hill operations will be treated in the order of the volume used in each department.

Milling.

Milling necessarily constitutes the most important and heaviest load. In the department there are installed 33 motors, having an aggregate of 1897 h.p. in connected load.

In the West Mill No. 1 one 250 h.p. motor is installed to drive the vanner and table floors and one 200 h.p. motor for jigs, rolls, etc. The main motor drives of West Mill No. 2 are practically identical to those of West Mill No. 1. On the floor near the pulley or rope drive is what is called a motor tell-tale or safety device which is installed on our more

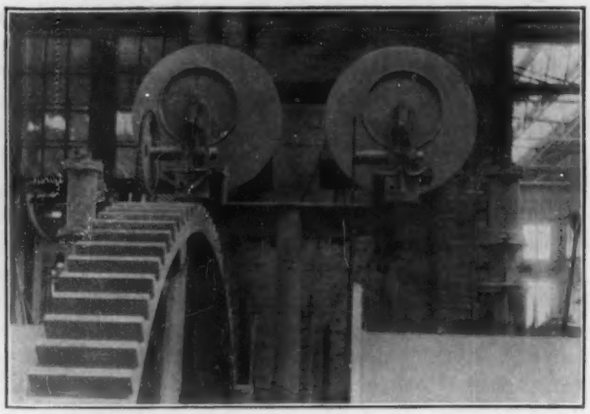
Air Operated Brakes and Clutches with Safety Overwind for Electric Hoist.

important motor drives. This device was invented and patented by M. J. Bottinelli, foreman of the electrical department at the Bunker Hill plant. The bar near the rope has a pivoted stem which in turn engages a cam on the vertical stand. A cord passes around this cam and suspends the heavy carbon contact in the case at the bottom of the stand. If a strand becomes loose it strikes the bar and trips the cam, allowing the carbon contact point to drop into the copper terminals. This connection introduces current into the solenoid attachment on the oil switch of the motor. A tappet is attached to the plunger or armature of the solenoid, and when the current is introduced the plunger with tappet kicks up sharply and throws out the oil switch, stopping the motors.

By thus calling attention to the loose strand before it has unraveled far the strand may be tucked and little time lost; whereas if the rope did not have immediate attention the strands would unravel, possibly wind up in other ropes or equipment and do a great deal of damage. One of the most important duties of the device is its safety first feature used in connection with stopping the motor from some distant point in the plant. Wires are run from the solenoid to different parts of the mill and small knife switches put on the circuit in convenient places. In case of accident on the jig floor, for instance, to a man or machinery the workman can stop the mill by throwing on one of these knife switches, and it is impossible for the operator in the motor room to start up again until the knife switch is again opened. This device is a valuable protection to life, property and lost time.

Rock House.

In the Rock House there is installed over the spillway on the conveyor belt carrying the ore to the crushers a 36 in. 250 volt electro-magnet made by the Electric Controller & Manufacturing Company. This magnet extracts all large pieces of iron or steel before they can enter the crusher. Varied collections of such things as drills, drill bits, hammers, track spikes, monkey wrenches, car links, nails, spectacles and innumerable tobacco cans are collected at this point. The magnet being placed over the pulley at the discharge end of the belt at an angle renders the tractive effort or pull more efficient on account of the broken or loose condition of the ore just at the moment of spilling onto the grizzlies. This magnet saves many dollars



The Overwind Device for the Electric Hoist.

in repairs to crushers, rolls, elevators, etc., by the elimination of all kinds of scrap iron or steel from the mill feed.

Frequently pipemen, mechanics or electricians will lose or accidentally drop tools into the ore pockets underground and can almost invariably get these the next day from the crusher man who finds them on the magnet. Recently a new locomotive pinion was accidentally dropped into the ore pocket and later recovered at the Rock House.

Mine Pumping.

The next and possibly the most important application of electrical energy is in the mine pumping. For this work they have two independent cables carrying 2300 volts strung from the power house to the collar of the shaft about 12,500 ft. distant. Each cable is kept hot or constantly in use either by the mine pumps or hoist. Either one of these cables is sufficient to operate both hoist and pumps, but as a factor of safety the two cables are independently installed. There are five motors installed for mine pumping, having an aggregate connected load rating of 535 h.p.

Each pump circuit is equipped with a General Electric curve drawing ammeter which records in red ink for the full 24 hours, the time of starting, stopping and amount of power used. By the close scrutiny of these charts the careless starting of the motor, the condition of the pump valves, pipe column and other mechanical conditions are revealed.

There are 595,150 gallons of water per day pumped from the shaft at a cost of $17.12 for electric current only.

Electricity as applied to pumping operations is surely in a class by itself. To attempt to pump this vast amount of water from a shaft over 10,000 ft. from the portal of the tunnel would seem nearly impossible by any other means. The improvements made in the past few years in the design and manufacture of 2300 volt motors, cable and underground electrical appliances is well illustrated by the instance of the flooding of the Bunker Hill shaft some three years ago when a fire started at the collar of the shaft, disabled all the electrical apparatus, causing one of these pump installations to be submerged under 200 ft. of water. The motor submerged was General Electric Form M three-phase 2300 volts. For three weeks this motor remained submerged while the shaft was being pumped out by use of two air pumps lowered into the shaft from the hoist cable. The motor was never removed from the pump and the rotor or armature was not taken out. Electric current at low voltage was applied to its windings—hot air blasts supplied by electric heaters were applied and the fourth day after dewatering the motor and pump was started without a hitch. A performance of this kind certainly speaks well for the manufacturer.

Hoisting.

Electric hoisting constitutes a very important application of electricity.

Our electric hoist, I believe, is the first successfully operated large induction motor hoist in the Coeur d'Alene district. When the Washington Water Power Company began making contracts in the district for power they objected very seriously to large induction motor hoist installations. After submitting to their engineers the details of acceleration and peak load control of the hoist they finally consented to take on the load.

The Cutler-Hammer switchboard controller used in the operation of the hoist is of the multiple solenoid type. There are primary contacts for handling the primary circuit and other contactors controlled by series relays for the control of the secondary circuit of the motor. The acceleration is automatic instead of manual. The engineer opens his controller wide at one stroke and the automatic features of this board control the amount of current taken and time of acceleration. The chart for hoisting operations conveys the same information as those taken on the electric pumping equipment only in a much more elaborate way. This chart travels at the rate of 8 in. per hour under a pen filled with red ink—each of the three strips marked "Morning," "Afternoon" and "Night" has recorded the actual number of times each engineer in charge moved the hoist drum for any purpose whatever. The first chart begins at 8 a. m. and this engineer is on duty until 4 p. m., the others follow, each for 8 hour shifts.

The straight upward mark from the base line indicates the amount of power or amperes applied to start the hoist—the amount of time elapsing before the pen returns to the base line indicates the time the hoist was turning. By this chart record which is made at the power house over 12,000 ft. from the hoist, an absolute check is made on the number of trips per hour or per day, the exact time the hoist moved for men and by careful study it reveals all that the engineer on each shift is doing, showing the periods of rest and enables the mine superintendent to so arrange all work in connection with the hoisting, to make to maximum efficiency. The charts will also record any accident, unusual condition of motor, track, weight of ore or careless handling by engineers, and as it is made or recorded on the outside of the mine it furnishes a constant report on the tonnage being moved each hour without the necessity of going inside or disturbing the engineer by phone.

During the year 1915 there was hoisted by the main hoist 422,853 tons at an average cost of 1.0473 kw.-hr. per ton or .00689 cents. This electric hoist replaced an air hoist which, however, is still maintained in position and working order on the opposite side of the shaft to be used in case of emergency.

The air for this hoist is reheated by electricity. The valve arrangement on the pipe lines permits of bypassing the heaters when it is necessary to make repairs without unnecessary interruption in hoisting. These heaters require 90 amperes each at 110 volts and are provided with switches which permit of six different heats. Thus the amount of heat required can be given in proportion to the demands of the hoist. This form of compressed air heater has proven very efficient.

Traction.

All ore, timbers and men are moved in and out of the mine by electric locomotives. The ore is first assembled at the shaft pockets by storage battery locomotives, then hoisted to the Kellogg tunnel level by the electric hoist, where it is loaded into larger cars and trams and taken by trolley locomotives to the mills about two miles distant.

Water for the storage batteries is brought into the mine each day in five gallon canvas water bags, the same as those commonly used by prospectors and autoists. The ore assembly trains hauled by the storage battery locomotives average 8 cars per train, each car of 34 cu. ft. capacity or approximately 6000 lb. per car or 24 tons of ore per train. The average distance for storage battery hauling on all levels is approximately 1000 ft.

For charging purposes a motor-generator set consisting of a 50 h.p. three-phase 2200 volt motor connected to a 125 volt d.c. generator is used. This set is located on the 1300 ft. level and supplies battery locomotives on 12, 13 and 14 levels. The motor generator set is provided with circuit breakers and reverse current relays which protect it from overload as well as possible reversal of current due to low voltage or stopping of generator while charging.

After the ore is hoisted to the Kellogg tunnel level it is hauled by 500 volt trolley locomotives to the ore bins. The locomotives used in this work are usually of the 8 ton class and are nearly all of the General Electric make—one being a Jeffrey. The tail light used consists of an A-4 Edison battery and 1½ volt lamp placed in an iron box back of a regulation caboose red lens. This box is provided with hooks to hang over the end of the car. It is placed to one side of the center line to facilitate the coupling and uncoupling of empty timber trucks. The A-4 Edison battery used for these lamps requires charging every 30 days, and extra cells are kept constantly on hand.

The main Kellogg tunnels trains are composed of 17 cars each, each car having a capacity of 46.4 cu. ft., holding approximately 3¾ tons per car or 63 tons of ore per train.

Beside the regular train service for the ore hauling, all timbers, mine supplies, coal and wood for the boiler plant is handled by 500 volt trolley locomotives. In all the traction work of the Bunker Hill Company they have over eleven miles of trolley lines and 18 locomotives, representing all makes, with the General Electric predominating.

In the locomtive repair barns provision is made for the rapid disassembling of locomotives for repair purposes.

Block Signal System.

Our block signal system consists of red and green lamps placed every 400 ft. along the tracks underground. The switches for both green and red lamps are located at the end of each block.

The system is manual operated and in no way automatic. Each motorman is responsible for maintaining his own block. On entering the Kellogg tunnel the switch is thrown which lights green lamps every 400 ft. for the full length of the first block or to the side, approximately one mile. The frequency of the green lamps even though the tunnel is full of smoke or steam gives him assurance that he is alone in the block as anyone entering from the opposite end would have put on the red lamps. On leaving the block at the side track he extinguishes the green lights behind him by use of another switch which constitutes the second point of control in this circuit. Each block operates the same way, all locomotives going out light the red lights while those entering the mine light the green ones.

All switches for red or green lamps are indicated by an electric lighted letter or similar color.

The same block signal system applies to the yard trolley system where bells are used in place of colored lamps.

In addition to the block signal system all hoist bells, flashes and telephone signals are operated underground by use of 110 volt a.c. current.

The hoist bells are made up of plain 14 in. gongs equipped with ordinary trip coils, the same as found in the automatic oil switches. This signal system provides a lamp in connection with the hoist circuit so arranged as to light every time the bell strikes. Anyone standing at any station can count the bells given by watching the lamp over the signal switch at that station. When a signal is given the person giving it can be sure the right signal was pulled by watching the lamp flashes at the switch.

All underground telephones are equipped with an auxiliary circuit of 110 volts to operate Russell horns —these horns take the place of bells and the weird sound can be heard far down the drifts or above the noise of pumps, hoists or escaping air.

The Power House.

In the Power House we have two compressors, the first one is a Nordberg with a capacity of 3300 cu. ft. free air per minute. This machine is not electrically driven. It is driven from a steam engine on one end and a 500 h.p. turbine water wheel on the rope drive over the fly wheel at the other end. The second large compressor has a capacity of 2400 cu. ft. free air per minute. It is made by the Ingersoll Rand Company and is driven by a 400 h.p. induction motor.

A Curtiss steam turbine is installed as an auxiliary plant in case the current supply of the Washington Water Power Company should fail. This turbine is of 750 h.p. capacity and will care for our hoisting, pumping, and traction loads while the water power service may be off. In this connection I will say the service given by the Washington Water Power Company has been most excellent as the interruptions have been very far apart. The turbine is kept in readiness to start on a few moments' notice and can be connected to the main load inside of seven minutes after the power goes off.

Nearly all the switches are of the double throw type so arranged that the circuit it controls can be placed on either the Washington Water Power Company's lines or on the steam turbine.

FUTURE OF AMERICAN ELECTRICAL SUPPLIES IN NORTHERN CHINA AND RUSSIA.

While nearly all articles of metal manufacture showed large reductions, the share of the United States in these imports was commensurate with its increase elsewhere. No separate figures are kept by the customs of the countries of origin of such imports, but the increased display and use of American mechanical and electrical appliances, as well as the certainty that other sources of supply were almost cut off, indicate our real introduction into this market. Throughout the year this consulate had many applications from dealers in the district, from eastern Siberia, and ever as far west as Irkutsk and Tomsk, for information as to American manufacturers, freights, and prices. Some of them placed orders directly in the United States, some with the few local agents of American firms, and some with American firms located in Tientsin or Shanghai.

The war in Europe has given to manufacturers in the United States their great opportunity. In spite of the lack of ocean shipping facilities, the difficulties with the railways that feed this market, the inadequacy of present banking and credit methods, and the ruling high prices of American products, American manufacturers have been able to place their goods in this territory. They are making friends with the Russian consumer—and it is not the Chinese trade but the Russian trade which is of chief importance in the immense territory that is destined to draw its requirements from Harbin—and their wares are becoming attractive to him. If this present and initial success is followed up, it need not be from necessity but from choice that the Mongol and the Muscovite may continue their buying from the United States even after the war has finished.

PREPARATION OF FOOD FOR ELECTRIC RANGE COOKING.

BY E. A. WILCOX.

Convenient for the Tenant.—On account of the absence of soot and burned foods, the utensils used on an electric range are easier to cleanse both inside and outside. Silverware in an apartment house never tarnishes as it does where gas is used. Unlike gas, electricity throws off no sulphur fumes.

Another condition that goes to make the electric range popular, is that an auxiliary supply of hot water is usually available for use in the apartment house, and may be utilized for cooking operations to attain quick results.

Desirable Central Station Load.—From an operating standpoint the apartment house business is very desirable for the central station company. The load is, for the most part, of an off-peak character. The load factor and diversity factor are both unusually attractive. The maximum demand is frequently shown to be not over one-sixth of the connected load. Compared with apartment house lighting and elevator loads the business is obviously more desirable.

Knowledge of Cooking Valuable.—For those interested in the sale of electric ranges or in the building up of electric cooking loads, a general understanding of how foods are prepared, why it is necessary to cook them, and the best methods to employ, will be of value. If one endeavors to interest a housewife in an electric range, he should know something about the use to which it is to be applied, otherwise he will not readily gain her confidence. Anyone familiar with the following paragraphs as well as with the natural advantages of electric heat, will be able to show the average housewife wherein electricity is superior to fuel heat in performing the various cooking operations suggested.

Reason for Cooking.—The cooking of food has much to do with its nutritive value. Many articles which are quite unfit for nourishment when raw are nutritious when cooked. It is also a matter of common experience that a well cooked food is wholesome and appetizing, whereas the same material badly cooked may be both unhealthful and unpalatable.

Purposes of Cooking.—There are three chief purposes of cooking. The first is to change the mechanical condition so that the digestive juices can act upon the food more freely. The second is to make it more appetizing by improving the appearance or flavor, or both. Food which is attractive to the taste quickens the flow of saliva and other digestive juices, and thus aids digestion. The third is to kill any disease germs, parasites, or other dangerous organisms it may contain. This is often an important object, and applies to both animal and vegetable foods.

Cooking of Meats.—For the most part meat is either boiled, stewed, fried, broiled or roasted. In general, it is probably true that cooking diminishes the ease of digestion of most meats. It may also remove considerable quantities of the nutrients.

Boiling of Meat.—If it is desired to heat the meat enough to kill bacteria in the inner portions of the cut, the piece must be exposed to the action of heat for a long time. If it is brought slowly to a boil, a good broth will be obtained, but the meat will be tough and tasteless.

If a piece of meat is plunged into boiling water or very hot fat, the albumen on the entire surface of the meat is quickly coagulated and the crust thus formed resists the dissolving action of water and prevents the escape of the juices and flavoring matters. Thus cooked, the meat will possess the desired meaty taste but the resulting broth will not be considered good.

It is impossible to make a rich broth and have a juicy highly flavored piece of meat at the same time. If the meat alone is to be used, it should be plunged into boiling water and kept at that temperature for about ten minutes, after which the cooking should be continued at about 180 degrees F. until the tissues become tender.

Stewing of Meat.—If both the broth and the meat are to be used, the process of cooking should be quite different from that of boiling. In stewing, the meat should be cut into small pieces so as to present relatively large surface area and, instead of being quickly plunged into hot water, should be put into cold water, in order that the juices and flavoring materials may be dissolved. The temperature should then be slowly raised until it reaches about 180 degrees F. where it should be kept for several hours. Treated in this way the broth will be rich, and the meat tender and juicy.

Roasting of Meat.—The principle difference between roasting and boiling, is in the medium in which the meat is cooked. In boiling the flesh is surrounded by hot water, whereas in roasting it is surrounded by hot air and acted upon to some extent by radiant heat. In both operations, if properly conducted, the meat fibers are cooked in their own juices.

When the meat only is to be eaten, either roasting, broiling, or frying in deep fat is a more rational method than boiling, for the juices are largely conserved in the meat.

Cooking of Vegetables.—Vegetables baked, roasted, fried or boiled, are used for preparing a large variety of dishes. The most common method of cooking is that of boiling in water. The steaming of vegetables is often resorted to, but the results are similar to those of the boiling process.

The simpler the method of cooking and serving vegetables the better. A properly cooked vegetable will be palatable and readily digestible. Poorly cooked, water soaked vegetables generally cause serious digestive disturbances. All vegetables should be thoroughly cooked, but the cooking should stop while the vegetable is yet firm. As long as the vegetable is kept at a temperature above 125 degrees F. changes continue to go on in the vegetable substance. The most marked of these are in the starch, and in the odor, color, and flavor of the vegetable. Overcooking changes and toughens the texture of vegetable foods, destroys the coloring matters, and volatilizes or otherwise injures the substances which contribute to its flavor.

Cooking of Breads and Pastries.—In breads, cakes, pastries and other foods prepared from flour, the aim is to make a palatable and higher porous substance that can be more easily digested than the raw materials could be. Sometimes this is accomplished simply by means of water and heat. The heat changes

part of the water content into steam, which, in trying to escape, forces the particles of dough apart. The protein (gluten) of the flour stiffens about the tiny bubbles thus formed and the mass remains porous even after the steam has escaped. More often, however, other ingredients, such as yeast and baking powder, are used to "raise" the dough. The baking powder gives off carbon dioxide gas, and the yeast causes fermentation in the dough and produces carbon dioxide. This gas acts the same as steam, only much more powerfully.

Baking of Bread.—Bread is placed in the oven as a heavy uniform mass, and comes out a light body of increased volume with a crisp, dark exterior—the crust—and a firm, spongy interior—the crumb. The crumb naturally heats more slowly than the crust. The moisture which it contains prevents its temperature from rising much above the boiling point of water (212 degrees F.) When first put into the oven the yeast begins to work but a temperature of 158 degrees F. kills it. The gas in the dough, however, continues to expand, and forcing its way outward, enlarges the loaf and gives it a spongy appearance. Meanwhile the crust becomes hard and dark and the heat changes its starch into stiff gum and sugar and dries out the moisture. The brown color is due to chemical changes known as "caramelization."

Baking Temperatures.—The heat in the oven should not be too great, or the outside of the bread will harden too quickly, and the crust will be thick and hard before the interior is done. Furthermore, the gas expanding in the crumb will be unable to escape through the crust and will lift up the latter, leaving great holes beneath it.

The temperature of an oven and the time required for baking depends upon the size of the loaves and the character of the dough. Small biscuits or rolls can stand a much hotter oven, and quicker baking, than large bread loaves. For ordinary purposes, a temperature of from 400 degrees to 500 degrees F. is satisfactory for a pound loaf of bread. An experienced cook can tell when an oven has reached the proper heat by inserting his hand, but a pyrometer, (as a thermometer for measuring high temperature is called) makes a much better guide for the ordinary operator.

Demand for Domestic Ranges.—Interest shown in the domestic range is increasing more rapidly than in any other single heating appliance. In line with the attention now being given to this type of apparatus, and the rapidly growing market for it, the manufacturers of heating apparatus are making many improvements in both their original designs, and character of product. A number of concerns which have heretofore confined their activity solely to the production of fuel stoves, have taken up the manufacture of electric ranges. The result of these developments has been a 50 per cent reduction in range prices during the past five years, greater reliability in the heating units, a larger diversity of designs from which choice of equipment can be made, and simpler and more desirable standards of construction.

Essential Qualifications of the Electric Range.—The features of the domestic range which make its use desirable to the customer, the central station, and to those having the marketing of the product in hand, are generally agreed upon by all who have given the subject their serious consideration. The range, first of all, must be of substantial and durable construction, and of pleasing appearance. The designs must be standardized as rapidly as possible with the economic object in view of lower costs and increasing production. Simplicity of operation and ease of handling and cleaning are also essential. The heating elements must be rugged, reliable and efficient. Furthermore, they should be so designed as to be easily, quickly, and cheaply renewed whenever troubles develop. The ovens must be well insulated with heat resisting material, readily accessible, and easily cleaned. Some provision for broiling, either in the oven or on the cooking surface, is generally considered necessary.

It is of interest to note that the early types of ranges were so designed as to keep down the connected load and the central station demand as much as possible, whereas the present tendency is to neglect this phase of the design in favor of larger capacity units capable of doing quicker work. This is a step in the right direction. The natural diversity of the range load, and the short period demands which it creates are of little moment in comparison with the necessity for greater speed of operation. Furthermore, there is no reason for believing that a range of high rated capacity will consume any more energy in performing its work than one of lower capacity. The efficiency may be approximately the same with either design.

Types of Heating Units.—Heat is usually generated in electric range units by the passage of current through high resistance wires or strips of metallic ribbon. Heating elements in common use may be classified into three different types—first, the enclosed type, second, the radiant type, and third, the reflector type.

Enclosed Type Elements.—These usually consist of a resistance wire or ribbon, enclosed between mica or asbestos strips, or surronded with an enamel or other electric insulating material of high thermal conductivity. The element is usually enclosed within, bound upon, or otherwise imposed against, a metal disc or grid which takes up the heat, and in turn dissipates it. The heat generated in such a unit is transmitted from the metal surface to the cooking utensil and thence to the food by conduction. When this type of unit is used in an oven, however, the heat is transmitted to the food through the air by convection.

It is obvious that this type of element takes a little longer to start heating than do open elements, because the mass of material of which it is composed has to first absorb a certain quantity of heat before it can begin throwing it off. It is claimed, however, that this type of element will lose less of the heat generated during a longer period of operation than the open coil element. There are certain apparent advantages in having the hot wires hermetically sealed, such as the prevention of oxidation and mechanical injury, but unless the insulating materials are able to withstand extreme temperatures they are liable to serious damage, if the voltage is higher than normal, or if the element is connected for a long period without some means of carrying away the excess heat that is generated. Most enamels melt before they reach a temperature of 1650 degrees F. (Cherry red).

SPARKS—CURRENT FACTS, FIGURES AND FANCY

The Supreme Court of Oregon has ruled that the State Public Service Commission has power to change telephone rates fixed by any city within the commonwealth.

* * *

Artificial rain from artificial clouds is a subject receiving much attention in certain humid states of America. It is said that spray pipes sufficient in number to create artificial rain may be erected at costs averaging one hundred dollars per acre.

* * *

In these very terse words the President advised Congress in his recent message to pass the Webb bill permitting combinations for export trade: "The thing must be done now, because the opportunity is here and may escape us if we hesitate or delay."

* * *

The federal government estimates that the oil lands in Colorado and Utah, which were withdrawn from entry a few days ago for the use of the United States navy, will yield not less than 500,000,000 barrels of fuel oil.

* * *

The prospect in the copper market seems to be according to a well known Boston authority that the next big development in the metal market promises to be the purchase by England and France of another half billion pounds of copper for delivery during the closing six months of 1917.

* * *

Importations of Nicaraguan products by the United States advanced from thirty-one per cent in 1911 to forty-nine per cent in 1914 and to sixty-seven per cent in 1915. The great increase during 1915 was due primarily to shipments of coffee and gold to the United States that formerly went to Europe.

* * *

Nearly a quarter of a million horsepower has made its exit from the United States during the past thirty months. At least reports say that two hundred and twenty thousand horses have been shipped to Europe during this period at a cost of nearly forty million dollars.

* * *

Gold imports in the United States since the beginning of the war have amounted to eight hundred and fifty-eight millions and the exports in that time two hundred and thirty-one millions. It is thus seen that a net importation of nearly two-thirds of a billion dollars is America's strong financial footing today.

* * *

The closing of the Panama Canal from September, 1915, to April, 1916, due to mammoth landslides in the Culebra cut led some people to make doubtful statements as to the ultimate feasibility of the canal. The six months just closed has witnessed, however, a return to the canal utilization of 98.6 per cent of number of ships experienced in the busiest six months prior to the disaster.

* * *

A tabulation of the one hundred and fifty-eight transits through the Panama Canal in October according to the time required by the ships, shows that eighty-nine of the ships, or more than half, were in the canal between nine and twelve hours. The percentage requiring over twelve hours was 30.7, and the proportion passing through in less than nine hours was 15 per cent.

* * *

Wireless in transmission network operation is becoming a feature that justifies itself as a possible means of transference of needed intelligence at times when telephone and transmission lines are maimed or temporarily put entirely out of commission. A Western hydroelectric company is to be congratulated as being the pioneer in initiating this policy of insurance of continuity of service.

* * *

The final filtering of answers to the question "what is best in engineering education" submitted to members of Tau Beta Pi, the honorary engineering fraternity and digested by Engineering and Contracting, brings out the facts first that extreme specialization should be avoided and, second, that the prime object of a college training should be the formation of good habits of thought that will endure through life.

* * *

Cato and Varro of ancient Rome had knowledge on seeds that is well worth the while for the power salesman to pass on to his electrical pumping client during planting season. Here is what they had to say: "Seed should be examined to ascertain that it is not sterile by age, that it is clean, and, particularly, that it is not adulterated with other varieties of similar appearances. I have seen those seeds on whose selection much time and labor have been spent nevertheless degenerate if men do not each year rigorously separate by hand the largest specimens."

* * *

The unprecedented growth of manufacturing of all sorts during the past eighteen months has been accompanied by an equally great increase in metal production throughout the United States, which in turn has been attended with a corresponding increase in the use of electricity for operations incident to the mining, milling and smelting of ores from which these metals are obtained, according to editorial comment in The Electric Journal. It may be added, nevertheless, that this increase in cost of copper is today putting off the much needed electrification of Western railways in the high Sierras and Rockies.

JOURNAL OF ELECTRICITY
POWER AND GAS

FOUNDED 1887

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Crossley Building, San Francisco

ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each,	.25

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CONTENTS

Multiple Arch Dams on Rush Creek 479

California Industrial Accident Commission's Report 481

Wireless Telephony 482
By Walter Haynes.

Electricity at the Bunker Hill & Sullivan Mine 483
By Walter C. Clark.

Future of American Electrical Supplies in Northern China and Russia 486

Preparation of Food for Electric Range Cooking 487
By E. A. Wilcox.

Sparks—Current Facts, Figures and Fancy 489

Editorials 490
Christmas.
Railway Electrification in the Northwest.
Electricity for Mining and Milling Purposes.
Pacific Coast N. E. L. A. Section.

Personals 492

Meeting Notices 492
Kilo Watt Club Gives Christmas Doings at Key Route Inn.
San Francisco Electrical Development and Jovian League.
Los Angeles Jovian Electric League.
Wass-hael!

Trade Notes 492

Use of Electricity in Testing Bread at Pomeroy 493

Results of Meter Testing 493

Examination for Electrical Draftsman 493

Book Review 493

News Notes 494

The semi-annual index for Vol. XXXVII, which is completed with this issue, will be sent upon request to any subscriber.

CHRISTMAS!

What a world of thought the very word portrays! In the spirit of confidence and faith in the glorious advance of the electrical industry and in contemplation of the part this great industry is contributing toward easing the burdens of man and in bringing out the wonders of all that is beautiful and true in human existence, this issue of the Journal goes forth to the readers bearing with it that message of Christmas greeting of nineteen hundred years ago: "On earth peace, goodwill toward man."

Railway Electrification in the Northwest

It has been reported on good authority that the Great Northern Railway Company is contemplating turning over its power sites in the state of Washington, particularly those at Lake Chelan, to the Montana Power Company for development to forward the electrification plans of the Great Northern.

Whether or not there is truth in this statement one is lead to follow the reasoning back of such a possible move and interesting conclusions are evolved.

Given the Chelan plant and control of a big plant at Priest Rapids on the Columbia, together with one of the several power plants which are possible on the west side of the Cascades and it is at once seen that a string of power plants would be available for railway electrification of unprecedented size and convenience of location for all railways of the Northwest.

Speculation is rife as to whether such a combination with the Montana Power Company, which now furnishes electrical energy for the excellent service of the Chicago, Milwaukee & Puget Sound in its mountain division, would not be an ideal economic move for handling the generation of electrical energy for the Great Northern and Northern Pacific railways.

At any rate the engineering fraternity will follow developments of this nature with unusual interest.

Electricity for Mining and Milling Purposes

Electricity is finding a wide application in the mines and mills of the West. On another page of this issue are detailed many instances wherein the Bunker Hill & Sullivan Mine of Kellogg, Idaho, is setting the pace not alone as one of the greatest, if not the greatest silver producing mine in the world, but also for setting new standards of mining and milling efficiency.

In operating the milling features of this great concern nearly two thousand electrical horsepower are required. One superiority of the electric drive is

shown at a glance to be the individual drive electricity affords as opposed to the composite drive necessitated under the old method. Under this arrangement the vanner and table floors are enabled to have independent operation from that of the jigs, rolls, etc., so that a temporary interruption of the one in no way effects the continuity of operation of the other.

The tell-tale or safety devices are also a feature worthy of note among the desirable characteristics of the electrically operated mill. Many a rope drive has come to an early end in its operating career due to a non-observance of the old adage that "a stitch in time saves nine." In this mill, however, an electrical trip completely shuts down the rope drive when a thread has become disjointed and its unravelling with the consequent danger to the drive as a whole is threatened.

Not only is safety to apparatus thus realized by electrical operation but danger to life is also lessened. An instance of this is seen in the remote control that has been instituted for shutting down the mill at various places, so that the operator has nearby control in case of emergency no matter where his duties may necessitate his presence in the mill. In case of accident on the jig floor, for instance, to operator or machinery, the workman can stop the mill by throwing one of these knife switches and it is impossible to start up again until the knife switch is again adjusted.

One of the most unique features of electrical operation is, however, to be found in the rock house. A large electric magnet is here installed over the spillway on the conveyor belt carrying the ore to the crushers in order to arrest the further conveyance of any iron or steel material that may have gotten into the ore line. The extreme usefulness of such a magnet is forcefully brought out upon examination of the varied collection that the electric magnet draws out from time to time. Drills, drill bits, hammers, track spikes, monkey wrenches, car trips, nails, spectacles and the eternal tobacco can are among the curiosity exhibits taken out by the tractive force of the magnet.

In the operation of the mine, the electric hoist plays a remarkable role of efficiency. In this mine is to be found the first successfully operated large induction motor hoist in the Coeur d'Alene district. The acceleration of the hoist is automatic instead of manual. The engineer opens his controller wide at one stroke and the automatic features of the switchboard control the amount of current taken and the time of acceleration. The charts drawn on the board will also record any accident, unusual condition of motor, track, weight of ore or careless handling by engineers.

Perhaps the most remarkable electrical feature of the mine is that of the electric drive for the pumps and their successful operation. Although the pumps are located ten thousand feet from the portal of the mine, they nevertheless operate at an exceptional standard of efficiency. In fact some years back the motors became submerged in water for three weeks under two hundred foot head and yet without removing the motor from the pumps or taking out the rotor or armature the fourth day after the dewatering they were again in successful operation.

Such typical performances as these make the electric drive for both milling and mining operation indispensable in modern practice.

Pacific Coast N. E. L. A. Section

A brilliant future seems in store for the newly-approved Pacific Coast Section of the National Electric Light Association. After months of effort on the part of Western central station men under the leadership of R. H. Ballard of Los Angeles the power companies of California, Nevada, Arizona and New Mexico have been granted authority to proceed with the organization and early in January a meeting of the executives at Los Angeles will consummate the project.

In no sense does this represent another organization in a field already overcrowded with associations. It merely means the more effective operation of one to which most of the central station men already belong. No additional expense is involved, as a due allotment from the national funds will probably suffice for carrying on local activities after it is once under way.

The first effect should be to strengthen the national organization and stimulate sympathetic interest of Western men in its activities. With the feeling that they may enjoy all the benefits of national affiliation together with all the advantages of local organization should come a greatly increased membership.

The new section will afford opportunity for adequate discussion and presentation of peculiar local problems. Line construction in sparsely settled districts, encouragement of hydroelectric development on the public lands, rates for electric cooking and water heating, the growth of electrochemical industries,—are a few of the questions upon which great light will be thrown.

Nor will the central station men be the only benefactors. The local conventions of the section will facilitate the attendance not only of power company engineers and commercial men but also of the representatives of the manufacturers and jobbers. Such questions as increased discounts on apparatus and appliances sold in the widely scattered communities of the West, better prices on ranges and closer cooperation among all branches of the electrical industry will undoubtedly be worked out to the satisfaction of all concerned.

The purposes to be accomplished by the association are well stated in the tentative constitution as follows:

The object of this association shall be to foster and promote the common interests of its members and to advance scientific and practical knowledge in all matters relating to electric light and power companies; also to establish cordial and beneficial relations with the public and kindred associations, and between manufacturers of electrical machinery and appliances and the members of the association.

The new section will be a substation in a great system for the transmission of experience. It will be a new center for the distribution of knowledge and in turn will feed vigorous thought back into the main system. Thus will sectionalization strengthen centralization.

PERSONALS

E. J. Wallis and **F. H. Leggett,** of the Western Electric Company, recently returned from a short business trip to Los Angeles.

H. L. Jackman, manager of the Western States Gas & Electric Company at Eureka, has returned from a trip to San Francisco.

Emory Wishon, assistant to the general manager of the San Joaquin Light & Power Company, spent a few days at San Francisco this week.

F. D. Fagan, manager of the Pacific Coast Division of the Edison Lamp Works, recently left for Los Angeles, where he will spend the holidays.

Wm. A. Burr, sales manager of the Nevada Engineering & Supply Company of Reno, Nevada, spent a few days during the week at San Francisco.

A. C. Youngholm, secretary and manager of the Electric Railway & Mfrs. Supply Company, at San Francisco, has left for a two weeks' trip East.

Geo. B. Sanford, manager of the Great Western Power Company, recently returned to San Francisco from a short business trip to Los Angeles.

B. J. Jakobsen, designing engineer with F. G. Baum, who has been absent from the United States on work in Peru, has returned to the office in San Francisco.

S. A. Taylor, president of the Electric Railway & Manufacturers' Supply Company, recently returned to San Francisco from an extended trip throughout the East.

C. Bassoe, electrical engineer and manufacturer of Norway, is a recent visitor at San Francisco, where he has purchased considerable machinery to be shipped to his country.

H. H. Cudmore, manager of the Mazda bureau of the General Electric Company of New York, recently arrived from Los Angeles and expects to spend a few weeks at San Francisco.

E. C. La Rue has been temporarily assigned to the Portland, Oregon, office of the U. S. Geological Survey, in order to classify water power lands in the Oregon-California land grant.

C. E. Condit, formerly assistant engineer with the Northwestern Electric Company at Portland, has recently accepted a position with the Arizona Power Company at Prescott, Arizona.

Wynn Meredith, of the firm of Sanderson & Porter, recently returned to San Francisco from a five months' stay in Oklahoma, where he was inspecting the company's work, which is being completed on a big pipe line.

Frederick Laist, formerly chief chemist for the Washoe Smelter Works at Anaconda, Montana, has been promoted to the position of general manager. Mr. Laist has recently evolved new electro-chemical processes of ore reduction for his company.

R. H. Ballard, of the Southern California Edison Company, in company with **H. H. Trowbridge,** attorney for that company, were recent visitors at San Francisco in connection with the consolidation of the Pacific Light & Power Company with their company, which was brought up before the Railroad Commission during the week.

John Frederick Farquhar, commercial department, Washington Water Power Company, Spokane, Wash.; **Jiro Komiya,** electrical engineer, Imperial Government Railways of Japan, Tokyo, Japan; **Harvey L. Lionberger,** construction foreman and engineer, Spokane, Wash., and **Archibald Johnson Robertson,** superintendent of Eastern Division Mt. Whitney Power & Electric Company, Visalia, Cal., have been elected associate members of the American Institute of Electrical Engineers.

J. W. Beckman, associated for a number of years past as electrical engineer with the Great Western Power Company, and formerly with the Aluminum Company of America and the American Cyanamid Company and the research laboratories of the General Electric Company, and **H. E. Linden,** hydroelectric engineer formerly associated with the Southern Sierras Power Company, Stone & Webster Engineering Corporation and the Sprague Electric Company, have opened engineering offices in the Balboa Building, San Francisco as the Beckman & Linden Engineering Corporation. They will specialize on expert investigation of the electrochemical possibilities adjacent to present and proposed power developments, including every stage in the design and construction of both chemical and power plants. They are also associated with the Chemical Development Company which has a well equipped laboratory for research work in electrochemical fields. Mr. Beckman was largely responsible for the establishment of the caustic soda and bleach electrolytic plant of the Great Western Electrochemical Company at Pittsburg, California, and has also had wide European experience.

MEETING NOTICES.

Wass-hael!

The electrical and machinery men of San Francisco have been bidden to observe this ancient festival and make merry on Saturday afternoon, December 23d, at Bergez-Franks restaurant. The invitation is signed by R. F. Behan as toastmaster and twenty-two others. The price is $2.50. An elaborate program of entertainment has been mapped out.

Kilo Watt Club Gives Christmas Doings at Key Route Inn.

Wednesday noon, December 20, the Oakland Kilo Watt Club held its second Christmas feed and Christmas tree. The electrical salesmen of the power company of the Oakland division, had for their guests, on this occasion, Mr. Wallace Briggs, general agent; Mr. E. W. Beardsley, general superintendent; Chas. E. Mynard, assistant treasurer, and other prominent electrical men. A general good time was enjoyed by all.

Los Angeles Jovian Electric League.

At the meeting of the Los Angeles Jovian Electric League on December 6th the speaker of the day was Edward F. Trefz. Mr. Trefz was formerly field secretary of the United States Chamber of Commerce and is now associated secretary of Los Angeles Chamber of Commerce. His subject—in keeping with the spirit of the occasion—was "The United States Chamber of Commerce." G. B. McLean, sales manager of the Pacific Light & Power Corporation, was chairman of the day.

San Francisco Electrical Development and Jovian League.

"A day in camp" was exemplified by the Boy Scouts at the December 13th League luncheon, one of the most interesting of the novel series which has been recently put on by the entertainment committee of which N. J. Prendergast is chairman. President L. H. Newbert introduced S. B. Gregory of the Arrow Electric Company as chairman of the day. The first of the speakers was W. S. Woolner, assistant engineer of the Northwestern Pacific Railway who recounted the good work being accomplished by the Boy Scouts on making better citizens. He was followed by H. D. Cross, national field comsioner for the Boy Scouts of America, who explained that the purpose of the organization was not militaristic, but to train boys to meet any emergency. He told of the good work being accomplished in teaching 200,000 boys. Meanwhile a squad of the boys went through many of the evolutions of a typical day in camp. The last speaker was Mrs. S. M. Richardson, chairman of the legislative committee of the Woman's Congress, who spoke earnestly against militarizing the public schools. She urged that the boys be taught the principles of

arbitration and moral and physical betterment. She believes that any attempt at military education should be standardized by the United States and not left to the action of the several states. She gave a strong plea for internationalism and world peace. At the conclusion of this interesting meeting a rising vote of thanks was given the boy scouts and the several speakers.

EXAMINATION FOR ELECTRICAL DRAFTSMAN.

The United States Civil Service Commission announces an open competitive examination for electrical draftsman, for men only. From the register of eligibles resulting from this examination certification will be made to fill several vacancies in this position in the Navy Department, Washington, D. C., at salaries ranging from $3.52 to $6 per diem, and vacancies as they may occur in positions requiring similar qualifications in the department at Washington or at any navy yard or other naval establishment of the United States, unless it is found to be in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

TRADE NOTES.

The port of Portland has awarded a contract to the Kilbourne & Clark Mfg. Co., of Seattle, to install two seats of wireless equipment on port tugs, to cost $3250.

The Hurley Machine Company announces the purchase of 100,000 square feet of land located at Taylor street and Campbell avenue, Chicago. Ground will be broken immediately for a factory with a capacity of 1000 Thor machines daily.

The Terry Steam Turbine Company of Hartford, Connecticut announces the appointment of Stephenson & Nichols, Monadnock Building, San Francisco, as their representatives in Northern and Central California and the Northern part of Nevada.

USE OF ELECTRICITY IN TESTING BREAD AT POMEROY.

According to the Pacific Power & Light Company's Bulletin, of Portland, Oregon, R. H. Kribs, superintendent of the Houser mill at Pomeroy, has been testing each day's run of flour for some time past by baking bread, and has devised a way of carrying on this baking so as not to interfere with his regular duties, and still be able to get fine results.

He has remodeled an electric incubator, using the heating coils and thermostat so that an even temperature is maintained at all times, while the raising process is being carried on. A No. 2 Copeman large oven is used for the baking proper.

Three loaves of bread are baked at one time, and the preparation is as follows: To one and one-half pints of water is added three-quarters of a cake of Fleishman's yeast, and when thoroughly mixed flour is added until a stiff dough is formed. This is placed in the raising compartment for about seven hours at a temperature of from 80 to 86 deg. F., after which it is taken out and one-half pint of water, three teaspoons of salt, two teaspoons of sugar and one tablespoon of lard are added and thoroughly mixed, after which flour, which had also been placed in the raising compartment and is warm, is added until all is stiff. This is replaced in the raising compartment for one and a half hours, and then worked down to be raised again for one hour.

Loaves are then formed, replaced for raising one hour, after which they are placed in the oven to bake.

While the loaves have been raising the oven has been warmed to five of the Copeman indicator and the loaves are placed in the oven at that temperature. The oven is then set to point six, at which it trips out and the oven door is not opened for sixty-five minutes, at which time the bread is ready to come out. It is golden brown on the outside, both top and bottom, and exceptionally white and smooth inside, being thoroughly done.

The electric bread raiser and electric oven make it possible to obtain absolutely the same results each time, and the daily testing of the flour has enabled Mr. Kribs to detect and rectify any little fault in the process of milling before a quantity of inferior flour is placed on the market, and as a result "Pomeroy Flour" has proven to be of the highest standard and an increased demand has resulted, which is taxing the mill to full capacity.

The time element of every oven varies slightly, but when once obtained can be duplicated indefinitely. DO IT ELECTRICALLY.

RESULTS OF METER TESTING.

In line with its policy of giving first-class electrical service, the Pacific Power and Light Company is spending a great deal of time and money in keeping its meters tested and repaired up to date.

During the first nine months of the year 1916 almost 5500 meters have been tested, which includes approximately one-fifth of the meters at Pasco, all the meters at Sunnyside and Prosser, 1300 meters at North Yakima, one-fifth of the meters at Toppenish, almost 1000 meters at Walla Walla, 358 meters at Dayton, 54 meters at Pomeroy, and five meters at White Salmon, totaling 4305 meters in Washington. The Oregon list includes 400 meters in Pendleton, 172 meters at The Dalles, 297 meters at Hood River, and 308 meters at Astoria and Seaside.

Mr. Junkin is now at Toppenish, and will remain there until he tests all of the meters at that place. He will then proceed to Pasco and complete the testing there.

Mr. Rutherford is now at Pendleton and will stay there until all the meters have been tested. He will then return to Walla Walla and attend to work at that office.

Arrangements have been made to test all the meters at White Salmon and Seaside this winter. Testing work at Hood River and The Dalles is carried on by the local force all the time and is up to date. The same is true at Pomeroy.

BOOK REVIEW.

Alternating Currents. By Carl Edward Magnusson, M.S., Ph. D., E.E. Size: 6 in. by 9 in.; 520 pp.; 475 illustrations; cloth binding. Published by McGraw-Hill Book Company, Inc., of New York City, and for sale at the Technical Book Shop, San Francisco. Price $4.00.

This book is an outline of lectures and class-room discussions in alternating-current phenomena given by the author during the past ten years to students in the University of Washington at Seattle where the author is professor of electrical engineering.

As explained in the preface to the book, its purpose is to aid the student in gaining clear concepts of what actually takes place in alternating current machinery, to explain the relations between the factors involved and to express the physical facts in mathematical forms in such manner that the student shall understand the equations and be able to use them rationally in the solution of every-day industrial problems.

A few typical problems are well chosen to illustrate the text and these problems add greatly to the value of the work.

Throughout the work the author has unconciously interwoven many fine points that are applicable to Pacific Coast conditions which are not to be found in other text books of this nature.

The treatment of phenomena connected with transmission lines is especially complete. The book should especially find a wide application among electrical engineers and technical colleges of the West.

NEWS NOTES

INCORPORATIONS.

GALLUP, N. M.—The Citizens Light, Power & Telephone Company is to be incorporated here with capital stock of $150,000. It is stated that the company is an affiliation of Gallup Telephone Company and the Gallup Electric Light Company and the company is to be affiliated with the Peoples Light & Power Company.

FINANCIAL.

HALF MOON BAY, CAL.—The Half Moon Bay Light & Power Company has been sold to the Western Power Company.

SAN FRANCISCO, CAL.—It is announced that the recent $1 assessment levied on the stock of the Northern California Power Company has been paid within the time allotted.

LOS ANGELES, CAL.—The public service commission has approved the $500 bond presented by the city of Pasadena to insure faithful performance of their contract to furnish electric current to the city.

SAN FRANCISCO, CAL.—The Mercantile Trust Company announces that bonds Nos. 39 to 43 and 57 to 160, inclusive, of Midway Gas Company first and refunding mortgage 6 per cent bonds will be redeemed for face value and accrued interest on January 15, 1917.

SAN FRANCISCO, CAL.—The Girard Trust Company of Philadelphia, as trustee of the Western States Gas & Electric Company, is calling for tenders for sale and delivery as of January 22 of the company's first and refunding mortgage 5 per cent gold bonds, due June, 1941, at a price not exceeding par, accrued interest and 5 per cent premium, to the extent of $48,927.81, the sum now available in the sinking fund. Tenders must state numbers of bonds offered and be addressed to Girard Trust Company, trustee, sinking fund, Western States Gas & Electric Company before January 8, 1917.

SAN FRANCISCO, CAL.—Offerings of the new $80,000,000 American Telephone & Telegraph Company 30 year 5 per cent collateral trust bonds is being made at a price of 98 and interest to yield approximately 5.15 per cent. These bonds are to be secured by pledge of stock of the New England Telephone & Telegraph Company, the New York Telephone Company, Southern Bell Telephone & Telegraph Company, Southwestern Bell Telephone Company, and Pacific Telephone & Telegraph Company, having a value of 133 1-3 per cent of the amount of bonds issued. The company agrees to maintain this margin of 33 1/3 per cent. The bonds are to be subject to redemption on any interest date at 105 and interest and are to have an annual sinking fund of 1 per cent of the maximum of bonds at any time issued.

SAN FRANCISCO, CAL.—A modified plan for the reorganization of the Northern Electric and the adjustment of the indorsements of Eugene de Sabla, E. R. Lilienthal, W. P. Hammond and the Sloss Bros. has been announced by John S. Drum of the reorganization committee, subject to the ratification of the security holders and the approval of the railroad commission. This plan includes:

1. A $2,000,000 authorized first mortgage bond issue, of which $1,000,000 will be used immediately for settling the prior claims, and furnishing approximately $250,000 for betterment, while the remaining $1,000,000 will be held in the treasury to meet 80 per cent of the cost of future intensive betterments.

2. An income bond issue, to be exchanged par for par for the present underlying bonds, and on a one-sixth basis for the present overlying bonds.

3. A separate agreement with the note indorsers under which they will be relieved of their obligation on the payment of an agreed sum which will probably be less than $1,000,000.

4. A five year agreement with the banks holding the notes and pledged bonds, under which they will receive 4 per cent for that term for the notes, which will be kept alive.

5. Common stock for the Sloss claims, unsecured notes, open accounts and the remaining five-sixths of the present overlying bonds, to an amount that the railroad commission may approve.

6. A 5 year voting trust, under which the present creditors, who are the virtual owners, will keep control for that time.

ILLUMINATION.

CHICO, CAL.—Bids for the installation of a lighting system in Chico have been called for by the board of trustees.

SACRAMENTO, CAL.—Bids are being received for installing electroliers at front and side entrances to the court house building.

LOS ANGELES, CAL.—Bids will be received by the board of supervisors for installing a street lighting system in Graham Lighting District.

MARTINEZ, CAL.—Manager Don C. Ray will submit a plan for lighting the entire city in accordance with which plan the lighting system will probably be reconstructed.

KLAMATH FALLS, ORE.—A modern street lighting system will be installed by the California-Oregon Power Company in Klamath Falls at a cost of more than $10,000.

WHITTIER, CAL.—The city trustees have awarded the contract for the ornamental lighting system for Philadelphia street to John L. Wilson, whose bid of $7390 was the lowest submitted for the job.

BURBANK, CAL.—Work on the new ornamental street lights on San Fernando road, through Burbank, between Providencia and Cypress avenue, will be started soon. Eighty-four electroliers will be installed.

LOS ANGELES, CAL.—An ordinance has been passed calling for ornamental lighting posts and appliances on Cherokee avenue between Sunset boulevard and De Longpre avenue and a portion of Leland way.

SANTA CLARA, CAL.—The committee appointed from the Chamber of Commerce to look into the electrolier question, stated that the entire work of laying wires and erecting standards could be done for about $2500.

LOS ANGELES, CAL.—The board of public works will receive bids for the installation of the necessary posts and appliances and for furnishing current for lighting Hobart street between Sixteenth street and Washington street.

BLYTHE, CAL.—B. McCready of Searchlight, Nevada, has been here looking up possible business for an electric light plant. It is believed that the city would support such a plant.

LOS ANGELES, CAL.—The city council has ordered cast iron ornamental lighting posts and appliances to be installed and electric current to be furnished for a period of one year for lighting Hobart boulevard between Washington street and Adams street.

PASADENA, CAL.—Owing to the fact that a resolution ordering work on the Mission street lighting system was adopted before the time for protest had expired, the city council has had to start proceedings over again. Both resolution ordering the work and one awarding the contract were rescinded and new resolutions adopted.

SANTA ANA, CAL.—The San Diego Consolidated Gas & Electric Company has applied to the board of supervisors for a franchise for the erection and construction of poles and wires for transmitting electricity along the public streets and highways within certain described territory. It is proposed by the board to grant the franchise and bids will be received.

TRANSMISSION.

WILCOX, ARIZ.—The common council has granted to Neil McMillan a franchise to construct an electric light and power plant in the city of Wilcox.

LOS ANGELES, CAL.—The city council has authorized the board of public works to enter into a contract with the Southern California Edison Company to construct, for $831.08, a temporary power line 2700 ft. long to connect Belleview avenue outfall sewer with the company's line near El Segundo.

RIVERSIDE, CAL.—The Southern Sierras Power Company has contracted to build a high tension transmission line from either Niland or El Centro, to Hanlon Heading, according to a statement of the vice-president of the company. This is part of a power system being built to irrigate a half million acres in Imperial Valley. The cost is estimated at $300,000.

LONG BEACH, CAL.—The job of reconstructing the city fire alarm system will be started immediately by laying underground all its wires and cables. The legislative body has authorized Commissioner Williams to contract, without bids, price not to exceed $2000, for materials and labor needed for the work.

KLAMATH FALLS, ORE.—In the city election here the people indicated to the city council by a vote of 566 to 122 that they were in favor of granting to the Keno Power Company of this city a 50 year franchise to supply electrical energy in the city. The Keno Power Company is a local concern, organized by the Kerns Bros. of this city. The only other company supplying electrical energy here is the California-Oregon Power Company, a California corporation.

CHICO, CAL.—A plan for a municipal lighting system through the use of his water rights on Deer Creek, which will be submitted to the board of trustees for consideration at a later date, was presented at a meeting of the Chico Business Men's Association by Denny Murphy. The construction of the power plant would cost approximately $500,000, and 25 miles of transmission line would be required. The total cost of the plant and wiring is estimated to be $750,000.

CALDWELL, IDAHO.—Governor Alexander and other members of the state land board have gone on record as favoring a plan by which it is proposed that the state shall build a power plant for the use of the Gem district. Attorney Rice and Dow Dunning have asked the board to ask the state to enter into an agreement with the government whereby the state would guarantee bonds to the amount of $3000 if the government would construct a power plant at Arrowrock, but the governor has insisted that the state build the plant and retain control of it until paid for by the settlers.

TELEPHONE AND TELEGRAPH.

TOMBSTONE, ARIZ.—With the taking over of the New State Telephone Company by the Mt. States Telephone Company, H. J. Evans becomes manager of the southern end of the district. New equipment will replace the old now in use on the lines taken over.

SANTA BARBARA, CAL.—Geo. B. Bush, president of the Santa Barbara Telephone Company, has been here in connection with the affairs of the company. He stated that plans for consolidation are well under way and the work of merging will be pushed as rapidly as possible. The estimated cost of putting the plants together is approximately $28,000. The plans include many expensive improvements in equipment.

SAN FRANCISCO, CAL.—Employes of the Western Union Telegraph Company will receive about $70,000 as a Christmas present, as the result of a special meeting of the board of directors in New York. It was decided that all employes receiving less than $1000 a year shall be given a bonus of 7 per cent of their salary and all employes paid more than $1000 shall receive a bonus of 6 per cent of their annual income. The awards will be made Christmas day.

TRANSPORTATION.

SANDPOINT, IDAHO.—A contract has been closed by the Northern Idaho & Montana Power Company covering power for the operation of a new box and shingle mill at Dalkena, Wash. This business will be served by the Newport division of the company.

SAN FRANCISCO, CAL.—Preliminary plans have been drawn by James J. Walsh at the request of local steamship operators for an elevated electric road along the waterfront from the Channel to Fort Mason, a distance of 2.8 miles. The estimated cost is $1,120,000.

GLOBE, ARIZ.—Through the action of the city council the street railway franchise which has been held by the Globe-Miami Traction Company has reverted back to the city. By the terms of the franchise, L. L. Litchfield, president of the company, will receive $1500, providing the franchise is eventually taken up, to reimburse him for money expended to interest capital in the project.

SACRAMENTO, CAL.—The judgment of the lower court of Sacramento, which issued an injunction restraining the Pacific Gas & Electric Company from building a street car track across K street on Tenth street in Sacramento, has been affirmed by the State Supreme Court. The appeal was taken by the Pacific Gas & Electric Company, which desired a straight track across K street, alleging a cumbersome switching connection hindered traffic at that point.

MARSHFIELD, ORE.—The Oregon Power Company has completed its 11,000 volt line from Marshfield to North Bend, which line was constructed for the purpose of better serving present power customers and to provide additional facilities for a large amount of new business. North Bend will have a community Christmas tree and the merchants are decorating the business district with streamers of eelctric lights, the illumination for all of which will be supplied by the Oregon Power Company.

IRRIGATION.

SACRAMENTO, CAL.—Bids are being received for furnishing and installing pumping machinery in the pumping station of Carmichael Irrigation District.

PARADISE, CAL.—The board of directors of the Paradise Irrigation District at their monthly meeting received word that the final report from the State Engineer's office will arrive within a few days. Petitions are in circulation asking for the bonding of the district to the amount of $350,000, and calling for a bond election, which will be held in January, or early in February.

REDDING, CAL.—On account of difficulties between Contractor Willison and the directors of the Anderson-Cottonwood Irrigation District, the former has paid off 200 hands and stopped work on his contracts with the exception of the tunnel and a small piece of work near Redding. Willison says he has completed sufficient work to receive $62,500 in addition to former payments but the directors refuse to pay him until the work is checked up by the chief engineer, causing him considerable inconvenience. His contracts amount to about $200,000 and are from 85 to 90 per cent completed. The contractor will return and finish the work.

FRESNO, CAL.—Over 100 men working with teams and scrapers, are being employed in cleaning the irrigation canals of the Fresno Canal & Land Company and the Consolidated Canal Company, preparatory to the opening of the irrigation season. Water will be turned into the canals in the early part of February. No improvements in either of the systems, in the way of extension or the erection of new dams, have been planned for the coming year. The Fresno Canal and Land Company has 346 miles of main canal, and the Consolidated Canal Company, 260 miles. Both are owned by the same interests.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co
Los Angeles; 755 Folsom St., San Francisco; Seattle.

B-1 Baker-Joslyn Company..... 10
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

I-1 Benjamin Electric Manufacturing Co.....
590 Howard St., San Francisco.

C-1 Century Electric Co..... 3
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co..... 2
87 New Montgomery St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 11
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co.....
Chicago, Ill.

D-2 Dearborn Chemical Company..... 12
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 Edison Lamp Works of General Electric Co.....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Co..... 12
206-8-10 First St., (near Howard), San Francisco.

E-3 Electric Agencies Co.....
279-283 Minna St., San Francisco; 419-421 E. Third St., Los Angeles.

E-4 Electric Storage Battery Co.....
743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co..... 12
34 Second St., San Francisco.

E-6 Electric Novelty Works.....
533 Mission St., San Francisco.

E-7 Economy Fuse & Mfg. Co.....
Kinzie and Orleans Sts., Chicago.

F-3 Federal Sign System (Electric).....
618 Mission St., San Francisco.

G-1 General Electric Co.....13-14-15
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

H-1 Habirshaw Electric Cable Co., Inc.....
(See Western Electric Company.)

H-2 Hemingray Glass Co..... 12
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-3 Haller-Cunningham Electric Co..... 12
428 Market St., San Francisco.

H-4 Hubbard & Co..... 3
(See Pacific States Elec. Co.)

H-7 Hurley Machine Co.....
New York and Chicago. (See Pacific States Electric Co.)

I-2 Illinois Electric Co.....
261-263 So. Los Angeles St., Los Angeles.

I-3 Interstate Electric Novelty Co.....
111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co..... 12
Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 16
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co.....
San Rafael, Cal.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

M-4 Morse Chain Company.....
Monadnock Bldg., San Francisco.

N-1 Nason & Co., R. N.....
151 Potrero Ave., San Francisco.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co.....
(All Jobbers.)

N-4 New York Insulated Wire Co.....
629 Howard St., San Francisco.

N-6 National Carbon Co.....
Cleveland, Ohio.

O-1 Okonite Co. (The)..... 16
(All Jobbers.)

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 12
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 16
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 Pittsburgh Piping & Equipment Co..... 16
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The.....
211 J St., Sacramento; 356 Market St., San Francisco.

S-4 Southern Pacific Co..... 2
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 4
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Central Bldg., Seattle, Wash.; 815 Newhouse Bldg., Salt Lake City, Utah.

T-1 Thomas & Co., R.....
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company..... 10
Pawtucket, R. I.

U-1 United Sheet Metal Works.....
575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company..... 3
St. Louis, Mo.

W-2 Western Electric Co..... 4
Eighth and Santee Sts., Los Angeles; 1900 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-3 Ward-Leonard Electric Co..... 15
Mt. Vernon, New York.

W-4 Westinghouse Electric & Manufacturing Co.....5-6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; First National Bank Bldg., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.

POLE LINE HARDWARE

HOT DIPPED — ROLLED THREADS

"The Joslyn Clamp that Holds"

SPECIFY "JOSLYN"—If your jobber hasn't it, we have—at three Coast warehouses.

We also carry:

"Macomb" Porcelain Insulators
"Brookfield" Glass Insulators
"Never-Creep" Guy Anchors
Galvanized Iron Wire and Steel Strand
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The letters and numbers in this classified directory refer to the full name and address of advertiser listed on preceding page

Adapters, Lamp
B-2, G-1, I-2.
Alarms, Burglar and Fire
W-2.
Arms, Cross
B-1, H-6, I-2, W-2.
Arms, Suspension (for electric irons)
S-3.
Anchors, Guy
B-1, H-2, P-2.
Arms, Mast
F-2, H-6.
Attachment Plugs
B-2, G-1, I-2, S-3.
Automobile Accessories
A-1, F-1, S-6, W-2, W-4.
Batteries, Dry
A-1, I-3, P-2, W-2.
Batteries Storage
B-1, E-2, E-4, F-1, W-5.
Bells, Electric
P-2, W-2.
Batteries, Wet
F-1, I-3, P-2, W-2.
Boilers
F-1, H-5, M-3.
Bolts, Expansion & Galvanized
B-1, H-6.
Boxes, Conduit
B-1, B-2, G-1, I-2, P-2, S-5.
Boxes, Wall
B-2, G-1, S-5.
Braces, Cross-Arm
B-1, G-1, H-6, P-2, P-5, W-4.
Brackets, Iron Pole
B-1, H-6, P-2, P-5.
Buss Bars
E-5.
Cables, Flexible
S-5, S-6.
Cables, Submarine and Lead-Covered
B-1, G-1, H-1, I-1, N-2, O-1, P-2, P-5, S-6, W-2.
Cable Connectors
E-6.
Cables, Telephone
B-1, I-1, S-6, W-2.
Carbon Brushes
E-5.
Chains—Silent—Power—Transmission
M-4.
Christmas Tree Outfits
A-1, P-2.
Circuit Breakers
F-3, G-1, W-2, W-4.
Clamps, Ground
G-1, H-6, P-2, T-1.
Cleats, Porcelain
B-1, G-1, W-2.
Clusters, Fixtures
B-2, G-1, I-2, P-2.
Coils, Armature
G-1, W-2, W-4.
Coils, Induction
W-4.
Coils, Spark
P-2, W-2, W-4.
Compounds, Boiler
D-2.
Condensers, Steam
H-5, M-3, W-5.
Conduit Fittings
E-3, I-2, P-2, S-5.
Conduit, Flexible and Rigid
B-1, I-2, P-2, S-5.
Conduit, Underground
P-5, S-5, T-2, W-2.
Controllers
C-4, G-1, W-4.
Contactors, A. C. and D. C.
G-1, W-4.
Converters
C-3, W-1.
Cord, Flexible Bell
G-1, S-6, W-2, W-4.
Cord, Lamp
B-1, G-1, I-2, O-1, P-2, S-6, W-2.
Cord, Telephone
B-1, W-2.
Cut-Outs
F-2, G-1, W-4.
Dimmers, Theater
C-4, G-1, P-2.
Drills, Electric
F-2, W-2.
Dynamos, A. C.
C-3, F-1, F-2, G-1, W-2, W-4.
Dynamos, D. C.
C-3 F-1, F-2, G-1, W-2, W-4.
Engines Gas and Gasoline
F-1, H-5, M-3, W-5.
Engines, Steam
F-1, H-5 M-3 W-5.
Fans, A. C., Portable
C-1, C-3, E-5, F-1, F-2, G-1, I-2, P-2, W-2, W-4.
Fans, D. C., Portable
C-3, E-5, F-2, G-1, P-2, W-2, W-4.
Fans, A. C., Ceiling
C-1, C-3, E-5, G-1, I-2, P-2, W-2, W-4.
Fans, D. C., Ceiling
C-3, E-5, F-1, G-1, P-2, W-4.
Fans, Exhaust
C-3, F-1, G-1, P-2, W-2, W-4.
Feed Water Heaters
H-5, M-3.
Filters, Oil
F-1, M-3, W-4.
Fixtures
B-2, B-6, P-2.
Flash Lights, Electric
A-1, I-3, P-2, W-2.
Fuse Boxes
G-1, P-2, S-5, S-6, W-4.
Fuse, Wire and Links
G-1, P-2, P-5.
Fuses, High Tension
P-2.
Fuses, Miscellaneous
B-1, G-1, W-2, E-7.
Fuses, Telephone
W-2.
Governors, Pressure
G-1.
Governors, Water-Wheel
P-5.
Guards, Wire Lamp
B-2, P-2.
Hand Starters, A.C. & D.C.
C-3.
Hangers
S-6.
Heating Appliances, Including Irons, Stoves, Etc.
C-4, E-5, G-1, I-2, P-2, P-6, W-2, W-4.
Hoists, Electric
F-1.
Hoods, Street
F-2, G-1, P-2, W-2, W-4.
House Lighting Outfits
E-2, E-3.
Insulators, Glass
B-1, H-2, P-2, P-5, W-2, W-4.
Insulators, High-Tension
B-1, E-3, G-1, P-2, P-5, T-1, W-2, W-4.
Insulators, Porcelain
B-1, E-3, G-1, P-2, P-5, T-1, W-2, W-4.
Insulators, Suspension
E-3, P-2, P-5, W-4.
Insulators, Wood Knobs
B-3.
Insulating Material
B-1, E-5, G-1, I-2, P-2, S-6, W-4.
Insulation, Moulded
B-1, C-4.
Iron Wire (Galv.)
B-1.
Jobbers
I-2, P-2.
Junction Boxes
S-6.
Lamp Standards
P-2.
Lamps, Electric Arc
F-2, G-1, N-3, P-2, W-2, W-4.
Lamps, Incandescent
E-1, G-1, I-2, N-3, P-2, W-2, W-4.
Lamps, Miniature
A-1, G-1, I-3, P-2, W-2, W-4.
Launch Lighting Outfits
E-2, E-3.
Lightning Arresters
G-1, W-2, W-4.
Line Material, Railway
B-1, G-1, W-2, W-4.
Lubricants
N-1.
Machinery, Mining
F-1, G-1, W-2, W-4.
Machinery, Transmission
M-4.
Magnets, Lifting
C-4.
Meters, Ammeters and Volt
A-1, F-2, G-1, I-2, P-2, W-2, W-4.
Meters Watt
F-2, G-1, W-4.
Molded Insulation
B-1, C-4.
Motors, A. C.
C-1, C-3, F-1, G-1, S-5, W-1, W-2, W-4.
Motors, D. C.
C-3, F-1, F-2, G-1, S-5, W-1, W-2, W-4.
Motor Protectors
F-2, G-1, W-2, W-4.
Motor Starters
C-3.
Novelties, Electric
A-1.
Oil Burners and Systems
F-1, L-1.
Ozonators
G-1, P-2, W-4.
Paint, Insulating
B-1, P-2, S-6, W-4.
Paints, Preservative
N-1.
Panel Boards
E-5, G-1, P-2, W-4.
Panels, Motor Starting
G-1, W-4.
Pins, Eucalyptus
B-1, M-2, P-2.
Pins, Iron and Steel
B-1, H-6, P-2, P-5, T-1, W-4.
Pipe, Riveted Steel
S-1, W-8.
Pipe Specials
P-7, S-1, W-8.
Piping Installations
P-7.
Plugs, Flush
G-1, P-2.
Plugs, Attachment
B-2, C-4, G-1, I-2, P-2, W-4.
Plugs, Stage
G-1, P-2, W-2.
Pole Line Hardware
B-1, H-6, I-2, W-2.
Poles, Iron and Steel
H-6, P-5.
Poles, Wood
P-5, W-2.
Power Plants
M-3, H-5.
Sprockets, Silent Chain
M-4.
Producers, Gas
F-1, W-5.
Pumps, Boiler Feed
F-1, H-5, M-3.
Pumps, Centrifugal
F-1, H-5, M-3.
Pumps, Deep Well
F-1, H-5.
Pumps, Vacuum
F-1, H-5.
Push Buttons
P-2, W-2.
Rail Bonds
G-1, W-4.
Ranges, Electric
F-3.
Rectifiers
G-1, P-2, W-1, W-4.
Reflectors
B-2, G-1, I-2, P-2.
Regulator, Boiler Feed
M-3.
Repairs, Electrical
W-4.
Resistance Units
W-3.
Resistances
C-4, G-1, W-4.
Rheostats
C-3. C-4, G-1, W-2.
Rheostats, Battery Charging
C-4, G-1, W-4.
Rheostats, Field
C-4, F-2, G-1, W-4.
Rheostats, Motor Starters
C-4, F-2, G-1, W-4.
Rock Drills
F-2.
Searchlights
F-2, G-1.
Separators, Steel
M-3, P-7.
Shades
B-2.
Signs, Electric
F-4.
Slate
D-4, E-5.
Sockets and Receptacles
B-2, C-4, E-5, G-1, I-2, P-2.
Solder, Self Fluxing
K-1 W-2.
Soldering Paste
B-1, E-5, F-2, W-4.
Power Transmission Chains
M-4.
Staples, Insulating
B-5, P-2, W-2.
Starters (Self), D. C. and A. C.
C-4, G-1, W-4.
Starters (Hand), D. C. and A.C.
C-4, G-1, W-4.
Strand (Galv.)
B-1.
Street Cars
P-5.
Switch Boxes
U-1.
Switch Lugs
E-6.
Switches, Float
C-4, G-1, W-4.
Switches, Disconnecting
G-1, W-4.
Switches, High Tension
G-1, P-5, W-4.
Switches, Knife
E-5, G-1, P-2, W-2, W-4.
Switches, Oil
P-2, W-2.
Switches, Pendent
C-4, G-1, W-4.
Switches, Push Button
B-1, C-4, I-2, P-2.
Switches, Snap
C-4, I-2, P-2.
Switches, Solenoid
C-4.
Switches, Poletop
G-1, P-2.
Switchboards, Power
E-5, F-2, G-1, W-2, W-4.
Switchboards, Telephone
W-2.
Tanks, Steel
F-1, W-5.
Tape
B-1, G-1, I-2, N-4, O-1, P-2, S-6, W-2.
Telephone Equipment
W-2.
Telephone Protectors and Terminals
E-3, P-5, S-6, W-2.
Tools, Construction
F-1, P-2, P-5.
Towers, Steel
P-2, P-5.
Transformers
B-1, C-3, F-2, G-1, W-1, W-2, W-4, W-7.
Transportation
A-2, N-5, S-4.
Trolley Bases
P-5.
Turbines, Steam
G-1 H-5, M-3, W-2, W-5.
Turbines, Water
M-3, P-4, H-5.
Valves
F-1, H-7, M-3, P-7.
Vacuum Cleaners, Electric
A-1, I-2, P-2, W-2.
Washing Machines
D-5, F-1, H-7, I-2, P-2, W-2.
Water Supply Systems
F-1.
Wire, Aluminum
P-5.
Wire, Annun'a and Office
I-2, S-6, W-2.
Wire, Armored
B-1, G-1, S-6.
Wire, Asbestos-Covered
G-1, S-6, W-2.
Wire, Bare Copper
B-1, G-1, N-2, P-2, S-6.
Wire, Enameled
G-1, W-2.
Wire, Magnet
G-1, S-6, W-2.
Wire, Rubber-Covered
B-1, G-1, H-1, I-1, I-2, N-4, O-1 P-2, S-6.
Wire, Trolley
B-1, P-5, S-6.
Wire, Weatherproof
B-1, G-1, I-2, N-2, O-1, S-6 W-2.
Wireless Apparatus.
H-3.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co.. Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 Atchison, Topeka & Santa Fe Railway Co..... 673 Market St., San Francisco; 1218 Broadway, Oakland.

B-1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co..... 590 Howard St., San Francisco.

B-5 Bridgeport Brass Co..... 9
(See Pierson, Roeding & Co.)

C-1 Century Electric Co..... 12
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co..... Crossley Bldg., 618 Mission St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co..... 3
Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 9
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-7 Economy Fuse & Mfg. Co..... Kinzie and Orleans Sts., Chicago.

E-1 Edison Lamp Works of General Electric Co..... Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 11
441 Golden Gate Ave., San Francisco.

E-3 Electric Agencies Co..... 247 Minna Street, San Francisco; Central Building, Los Angeles.

E-6 Electric Novelty Works..... 533 Mission St., San Francisco.

E-4 Electric Storage Battery Co..... 5
743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co..... 11
34 Second St., San Francisco.

F-1 Fairbanks, Morse & Co..... Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 Federal Sign System (Electric)..... 618 Mission St., San Francisco.

G-1 General Electric Co..... 10
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 General Vehicle Co..... 1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 Habirshaw Electric Cable Co., Inc..... (See Western Electric Company.)

H-2 Hemingray Glass Co..... 11
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-3 Haller-Cunningham Electric Co..... 4
428 Market St., San Francisco.

H-5 Hunt, Mirk & Co..... 141 Second St., San Francisco.

H-7 Hurley Machine Co..... New York and Chicago. (See Pacific States Electric Co.

I-2 Illinois Electric Co..... 261-263 So. Los Angeles St., Los Angeles.

I-3 Interstate Electric Novelty Co..... 111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co..... Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 12
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co..... Sunnyvale, Cal.

M-4 Morse Chain Company..... 6
Monadnock Bldg., San Francisco.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 Nason & Co., R. N..... 151 Potrero Ave., San Francisco.

N-6 National Carbon Company..... 3
Cleveland, Ohio.

N-2 National Conduit & Cable Co., The..... Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co..... 2
(All Jobbers.)

N-4 New York Insulated Wire Co..... 4
629 Howard St., San Francisco.

N-5 Northwestern Pacific Railroad..... 3
808 Phelan Bldg., San Francisco.

O-1 Okonite Co. (The)..... 12
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co..... 80 Tehama St., San Francisco.

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 9
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 9-12
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-6 Pittsburgh Electric Specialties Company..... 202 Aronson Bldg., San Francisco.

P-7 Pittsburgh Piping & Equipment Co..... 12
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The..... 9
211 J St., Sacramento; 356 Market St., San Francisco.

S-4 Southern Pacific Co..... 9
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 5
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co..... 3
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 Thomas & Co., R..... Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company..... Pawtucket, R I.

U-1 Union Sheet Metal Works..... 575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company..... 5
St. Louis, Mo.

W-2 Western Electric Co..... 5
Eighth and Santee Sts., Los Angeles; 1900 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-3 Ward-Leonard Electric Co..... 12
Mt. Vernon, New York.

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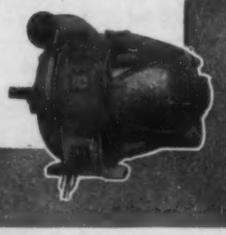

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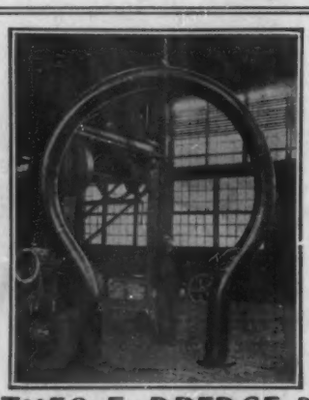

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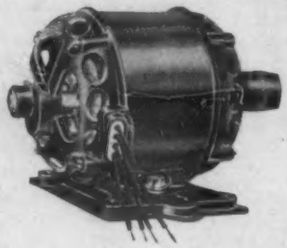

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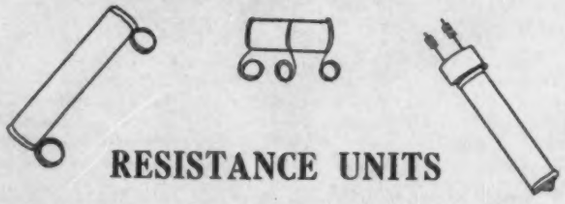

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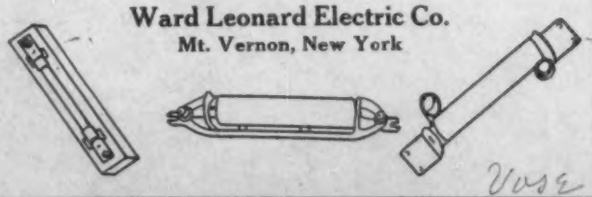
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